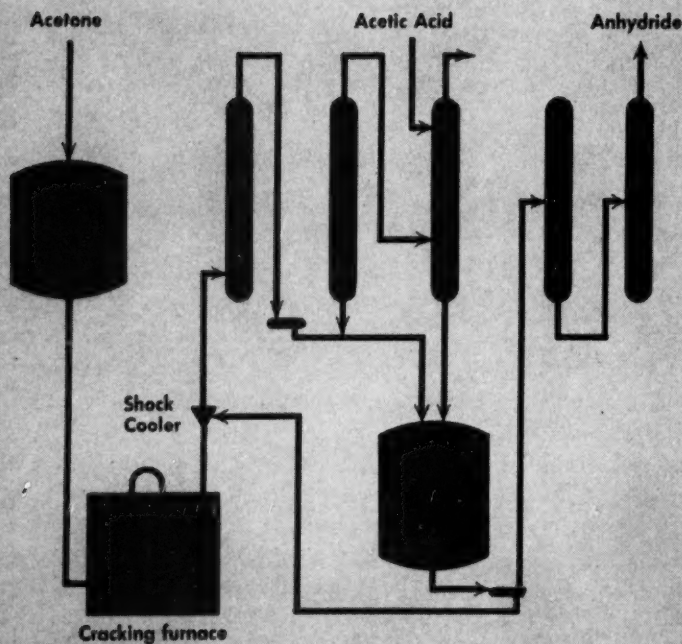


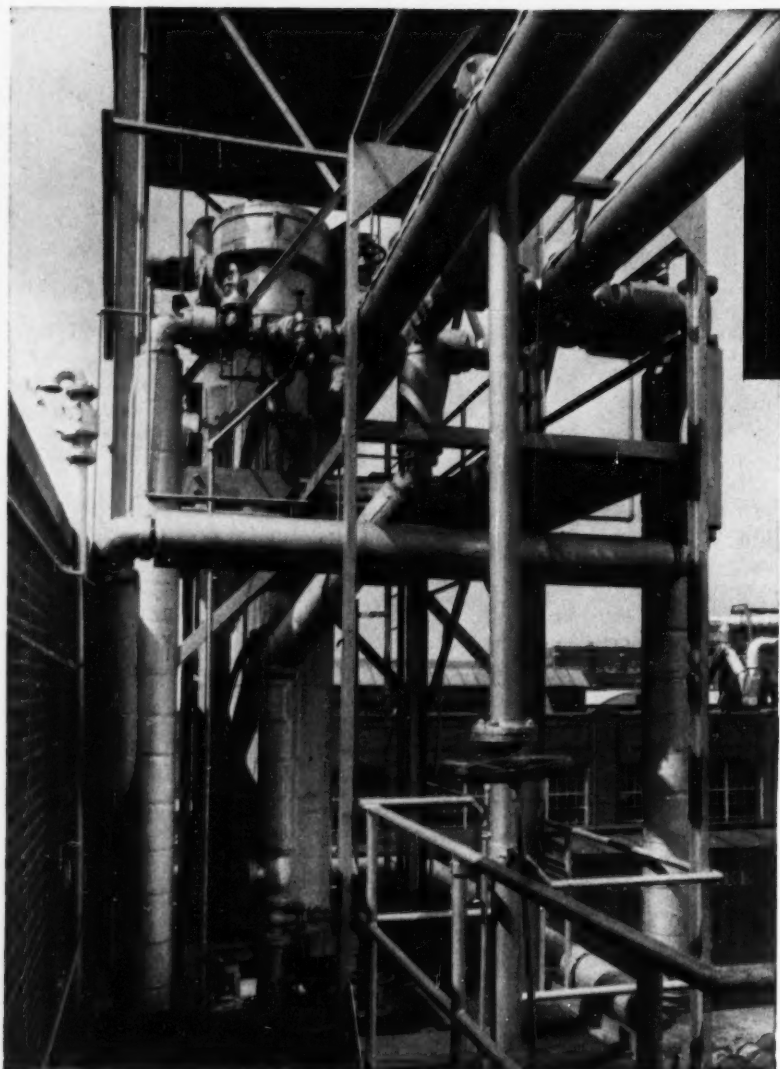
Chemical Engineering

FEBRUARY
1954

What's Happening in...



- Polyvinyl Butyral
- Wood Hydrolysis
- ◀ Acetic Anhydride
- Israeli Industry
- Hooker Cells
- Flotation Filtration



**HIGH SPEED
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apparatus
aids production
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resins

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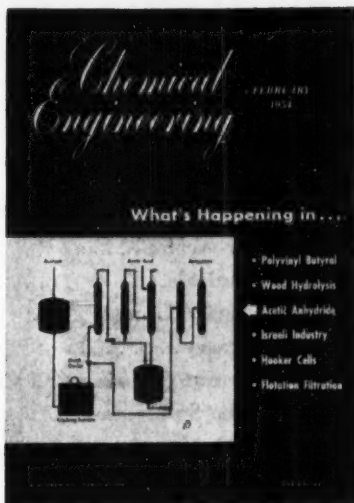
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GUIDED TOUR

JOHN R. CALLAHAN EDITOR



... **Keep tabs on what's happening in today's processes and technology.**

This month: Processes to turn out ethylene oxide by direct oxidation of ethylene ... how the Germans plan to make wood hydrolysis challenge corn as a source of dextrose ... special furnace turns thermal cracking of acetone into lucrative new route to acetic anhydride ... how tiny air bubbles separate hard-to-filter solids from liquids ... Hooker's assembly line cuts chlorine cell costs. (*What's Happening*)

The Trick We've Played

Now I can spill it: We've played a little trick on you.

Our January issue was what's known as an editorial "split run"—two versions of the same issue identical except for a few controlled variables.

One version—sent to a cross-section of 6,000 subscribers—had eight stories identical to those in the "regular" version—sent to 33,000 subscribers—except that one (but only one) editorial "technique" had been changed in each story.

Trained researchers then interviewed 1,000 representative subscribers getting each "version," asked them to indicate their degree of interest in each story. Nobody knew what had been changed.

We believe we're the first chemical and one of the few technical journals of any type to use this "split-run" technique as an editorial research tool.

Result: We can now make CE more useful to all our readers.—JRC

Next time use capitalized costs.

Engineer Jelen shows how to compare costs of alternative materials or methods, design or operations. He looks at differences in first cost, operating expense, obsolescence, salvage value. (*Article*)

Shortcut to heat exchanger design.

Carbide's Gilmour, top-notch design engineer, comes forth with more of his famous

Please turn page

GUIDED TOUR



tricks and shortcuts. They can help you cut your design time in half. (Article)



Nomograph solves humidity problems.

Here's a simple nomograph that gives you the absolute humidity for several common air-vapor systems. Saves time and trouble, no hunting for hard-to-find humidity charts. (Article)



How to cut your maintenance costs.

Maintenance can gobble up as much as half a firm's net profits! Jackson Leonard gives five ways guaranteed to keep costs high, then spells out how to topple them one by one. (Article)



Can you use any of these?

A resin to keep rubber flexible even after severe aging? Pre-processed ion exchange resins . . . phenolics that give chemical resistance to coatings . . . organic sequestrants . . . new herbicide? (Product News)



Rejoin GUIDED TOUR page 294

Chemical Engineering

FEBRUARY
1954

CHEMENTATOR 105

WHAT'S HAPPENING IN CHEMICAL ENGINEERING

Now—Anhydride From Acetone	114
Israel Expands in Chemicals	118
Polyvinyl Butyral Capacity Upped	122
A Twenty-Fifth Anniversary	126
Assembly-Line Methods Cut Chlorine Cell Costs	128
Dispersed Air Reclaims Solids	134
Yields More Ethylene Oxide	136
Wood Challenges Corn as Dextrose Source . .	138

PRODUCT NEWS

Rubber-Like Resin Aids Compounders	148
--	-----

FEATURE ARTICLES

Anhydrous NaOH: Today's Technology	183
<i>W. L. Badger and F. C. Standiford</i>	
Nomograph to Solve Humidity Problems	188
<i>Stuart Stern</i>	
Shortcut to Heat Exchanger Design—V	190
<i>C. H. Gilmour</i>	
Evaluate Your Depreciation Charges	195
<i>A. M. Hartogensis and H. D. Allen</i>	
Next Time Use Capitalized Costs	199
<i>Frederick Jelen</i>	
Thermal Conductivity Chart for Gases	204
<i>A. I. Johnson and Chen-Jung Huang</i>	
You Can Cut Maintenance Costs	206
<i>Jackson D. Leonard</i>	
How Speed Affects Compressor Performance . .	209
<i>Thomas E. Corrigan and A. F. Johnson</i>	

CE REFRESHER

Compression & Expansion—III	212
<i>Thomas E. Corrigan and A. F. Johnson</i>	

PLANT NOTEBOOK

- Pulsating Sampler Averts Plugging**..... 226
G. E. Schumann

YOU AND YOUR JOB

- Business for Yourself as a Chemical Jobber**... 236

CORROSION FORUM

- Chlorimet 2**..... 246
Walter A. Luce

TOMORROW'S TECHNOLOGY

- New Pebble Heater Design**..... 258
How to Get Pure Isopropanol..... 262
Your Checklist of New Patents..... 267

EQUIPMENT NEWS

- Procession to Mass Flow Rates**..... 270
Inside a Spinning Tube..... 284
Fluid Bearings in Sealed Pump..... 288

PICTURED FLOWSHEET

- Polyvinyl Butyral**..... 346

CHEMICAL ECONOMICS

- Government Statistics Can Help You**..... 353

OTHER DEPARTMENTS

- Book Reviews**..... 394
Convention Calendar..... 120
Firms in the News..... 402
Industry Trends..... 364
Man of the Month..... 374
Names in the News..... 366
New Technical Literature..... 464
Recent Pamphlets..... 398
Reader Service..... 460



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February 1954 Vol. 61—No. 2

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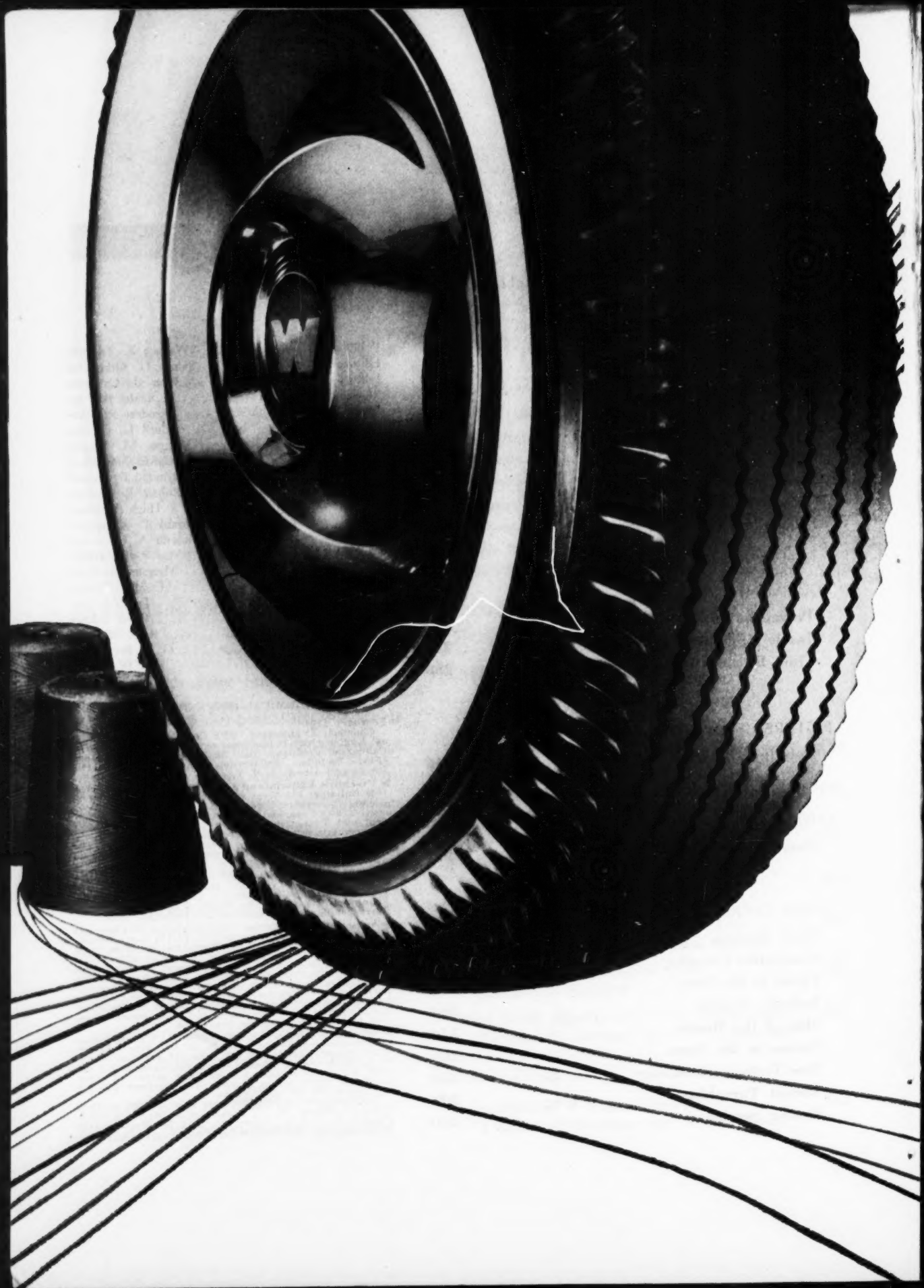
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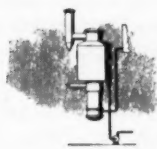
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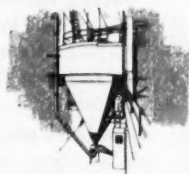
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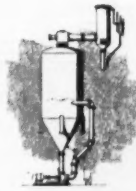
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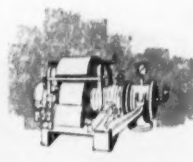
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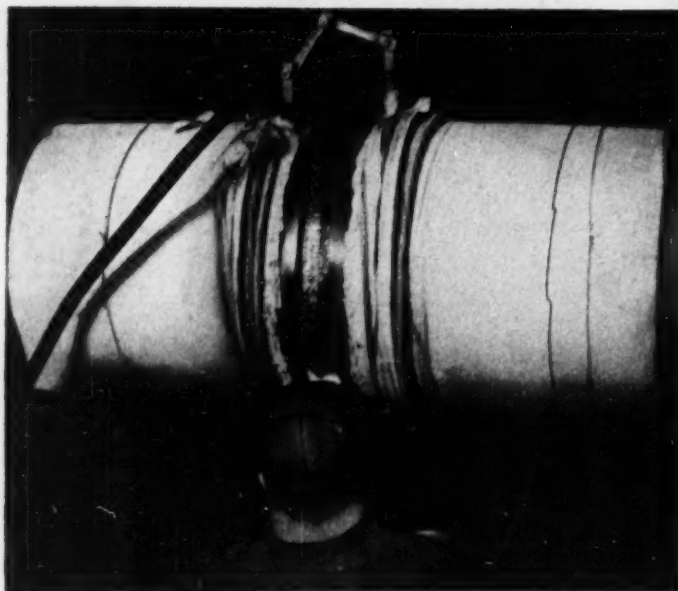
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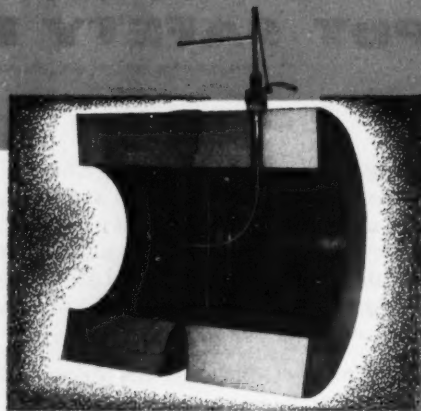
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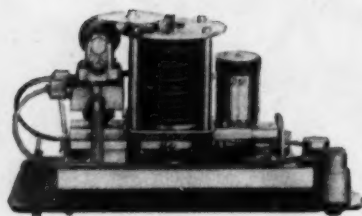
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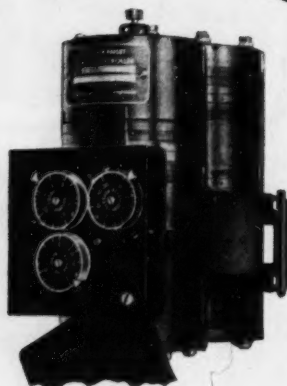
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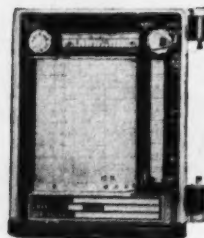
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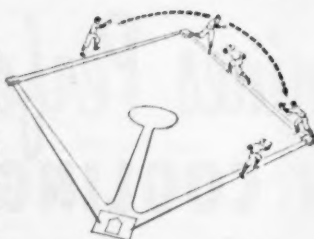
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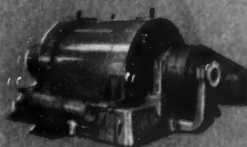
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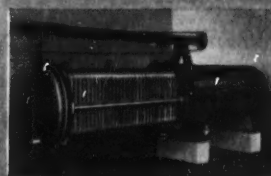
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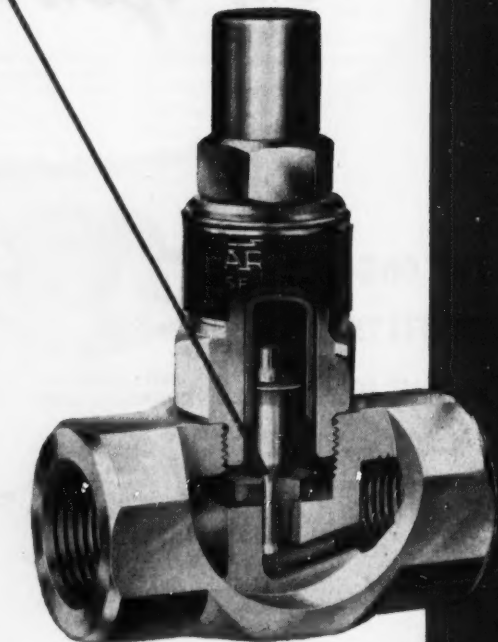
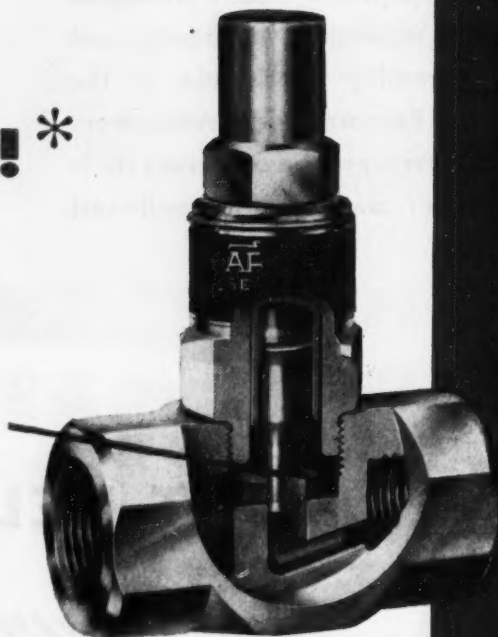
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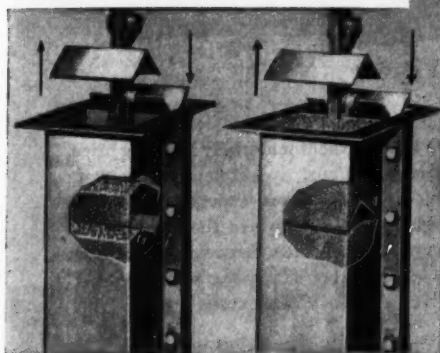
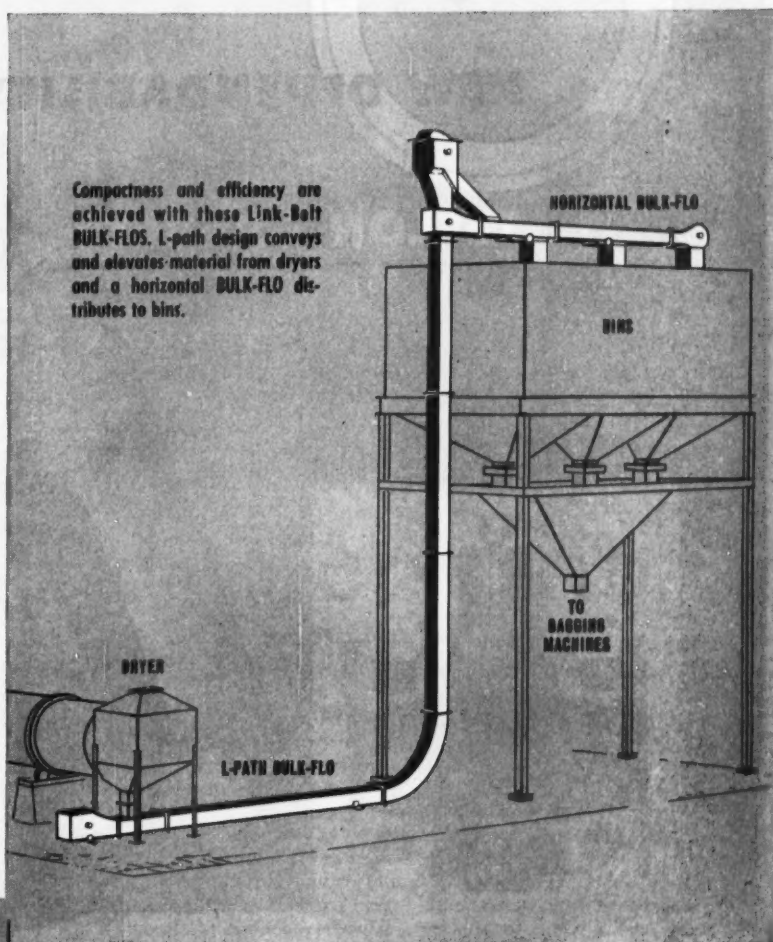


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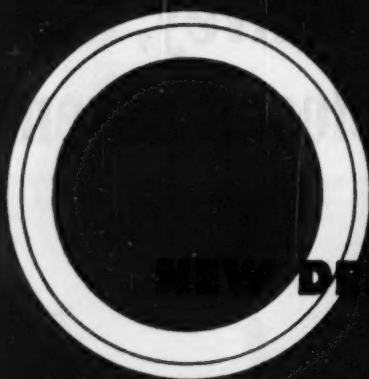
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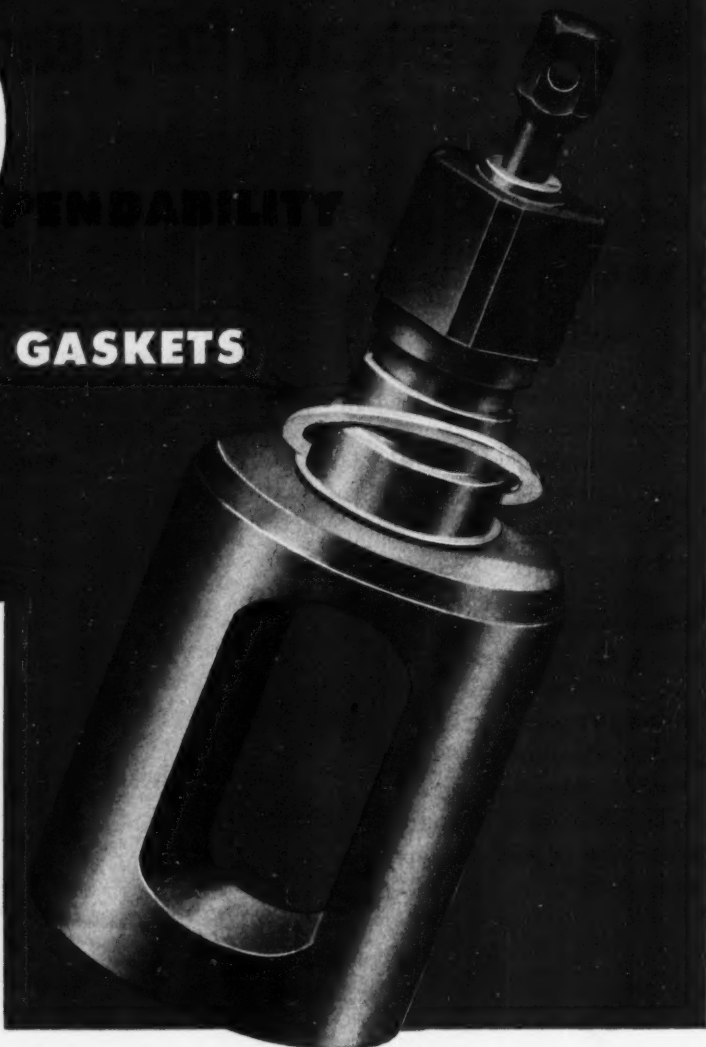
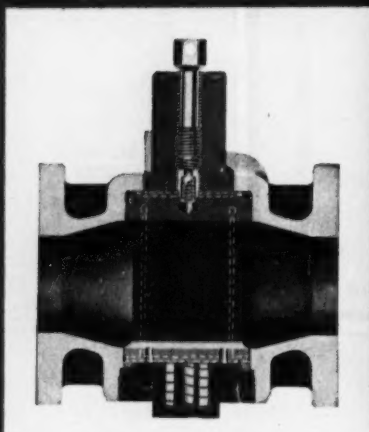
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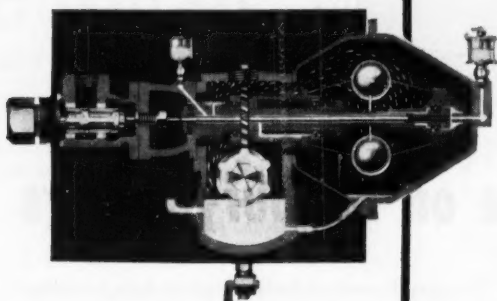
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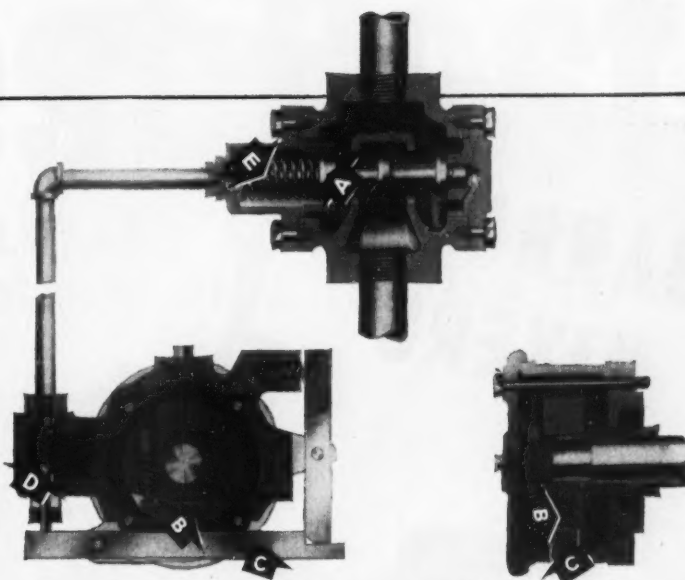
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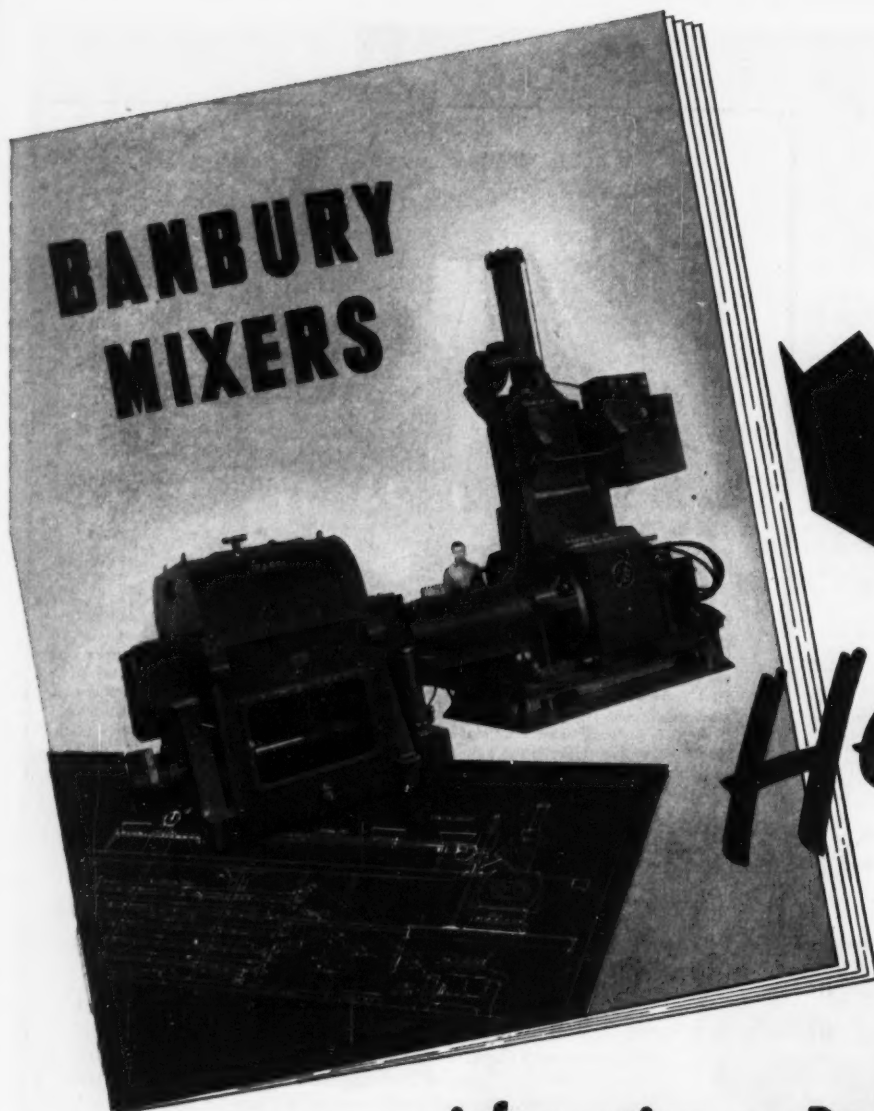
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COPPUS "BLUE
RIBBON" **TURBINES**



is the latest information on Banbury* mixers

For your free copy on the complete story of the latest Banbury developments, fill out the coupon below and drop it in the mail today.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Please send me, without cost or obligation, a copy of your new Bulletin No. 196, "BANBURY MIXERS".

Name.....

Company.....

Address.....

City..... State.....

This new, 32-page, illustrated bulletin gives data on recent design advancements in Banbury mixers, including the heavy-duty, "Uni-drive" machine which has been developed for high-pressure, short-cycle mixing.

Photographs of the different sizes and types of Banburys, and various applications with pertinent drawings are included, as well as information and illustrations covering related equipment such as, mills, calenders, extruders, etc.

A revised table listing the sizes and capacities of the complete line of Banbury mixers has also been included.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Akron, Chicago, Los Angeles, Houston

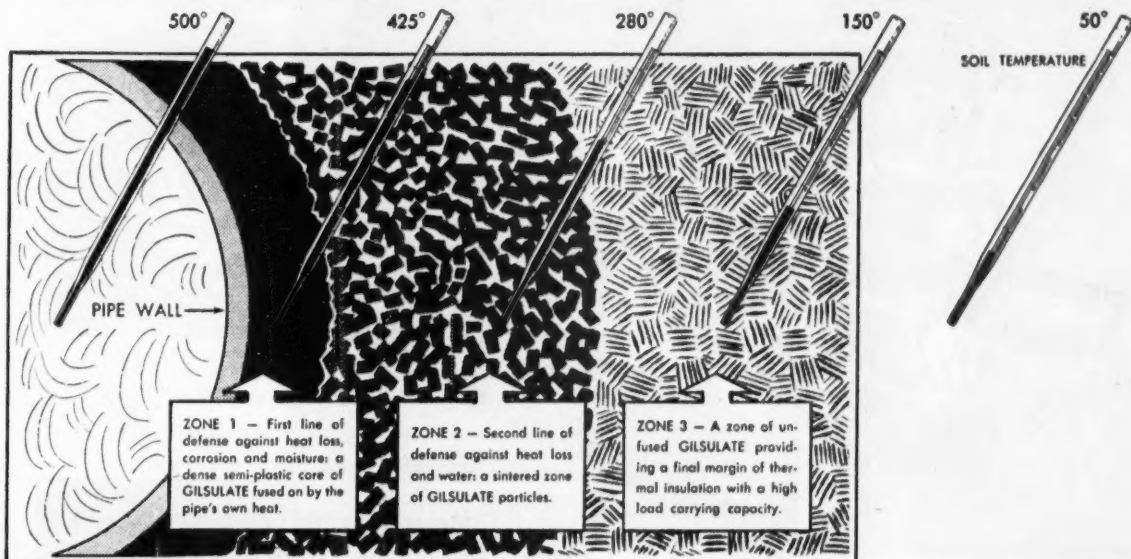
Farrel-Birmingham®

*Trade Mark

FB-885

Lowest Cost

PER INSTALLED LINEAR FOOT OF ANY
HOT UNDERGROUND PIPE INSULATION



GILSULATE®...the triple-zone insulation that fuses itself into lifetime protection for hot underground pipes. Water-proof, corrosion-proof, root-proof, acid/alkali-proof.

Compare your present insulation methods with Gilsulation:

1. Pour Gilsulate granules out of the bag onto the pipe; tamp it down.
2. Backfill: *the job is insulated!*

Gilsulate—nature's own insulation—is a unique, solidified hydrocarbon that virtually installs itself. Normal pipe-heat (up to 520°F) does the rest—fuses the Gilsulate to the pipe in hours, forming a massive circular solidified sheath.

Gilsulate costs less installed per linear foot than any other underground pipe insulation...it's easiest to use...and has been tested in scores of the country's largest and most important installations.

Some additional Gilsulate advantages:

- 3 grades available—220° to 520° F
- needs no sleeves or mechanical sheaths
- requires no mixing or special handling
- can't be punctured—leave rocks in backfill
- pipe expands and contracts within Gilsulate structure
- proved in actual use in hundreds of new construction and replacement installations

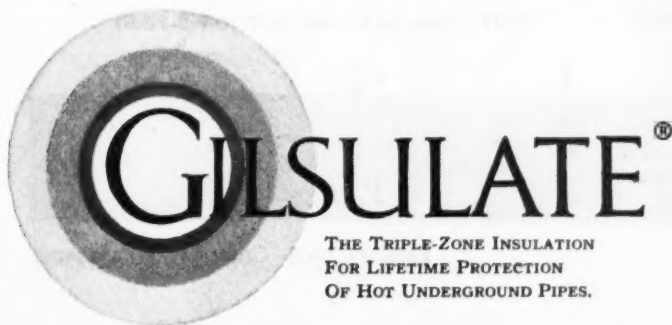
Send coupon for descriptive literature.

AMERICAN GILSONITE COMPANY
SALT LAKE CITY, UTAH

Affiliate of Barber Oil Corp. & Standard Oil Co. of California



No skills necessary—simply pour Gilsulate out of 100 pound bags, tamp and backfill. Can be used under any and all conditions—no matter how many pipes, whatever the space.



American Gilsonite Company
134 West Broadway, Salt Lake City 1, Utah
or 1145 East Jersey Street, Elizabeth 4, N. J.

Please send me descriptive literature on Gilsulate.

NAME

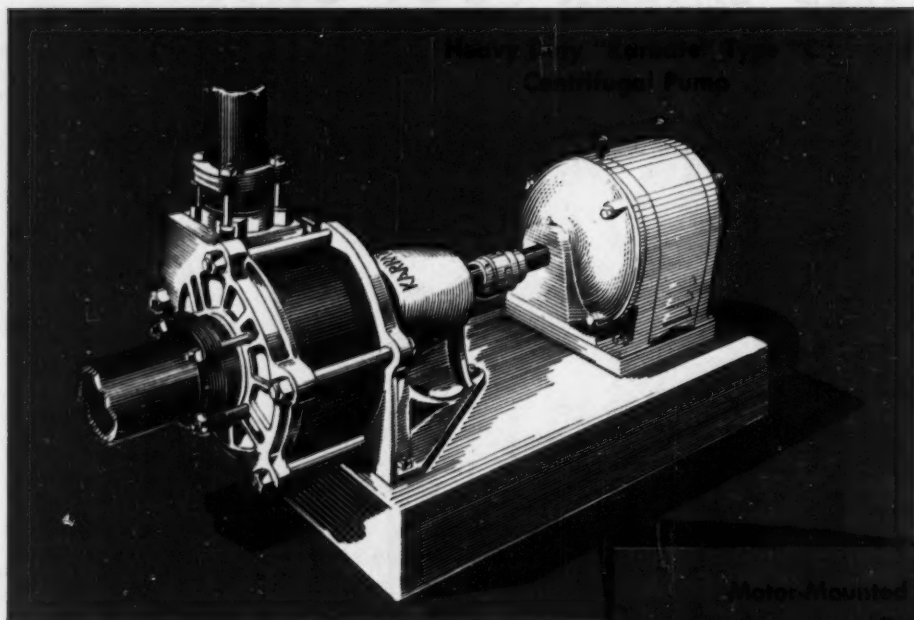
TITLE

COMPANY

ADDRESS

WANT THE BEST...

FOR ALL CORROSIVE SERVICES?



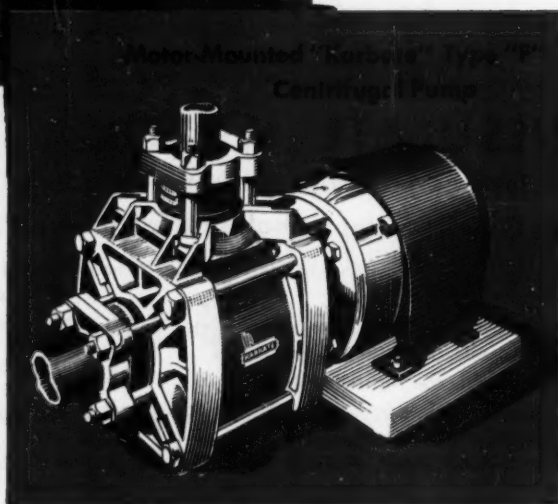
NEW DESIGNS...

IMPROVED PERFORMANCE!

- ★ Mechanical seal with enclosed coolant
- ★ Rugged Type SN armored connections
- ★ Maximum interchangeability of parts
- ★ Wide capacity range
- ★ Separable impeller and pump shafts

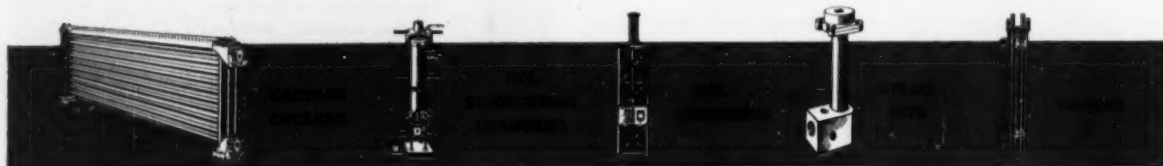
Offering peak performance at low cost, National Carbon's improved, general-purpose, "Karbate" brand centrifugal pumps banish operating troubles *wherever* corrosion is a factor.

Completely resistant to practically all corrosives over a wide temperature range, "Karbate"



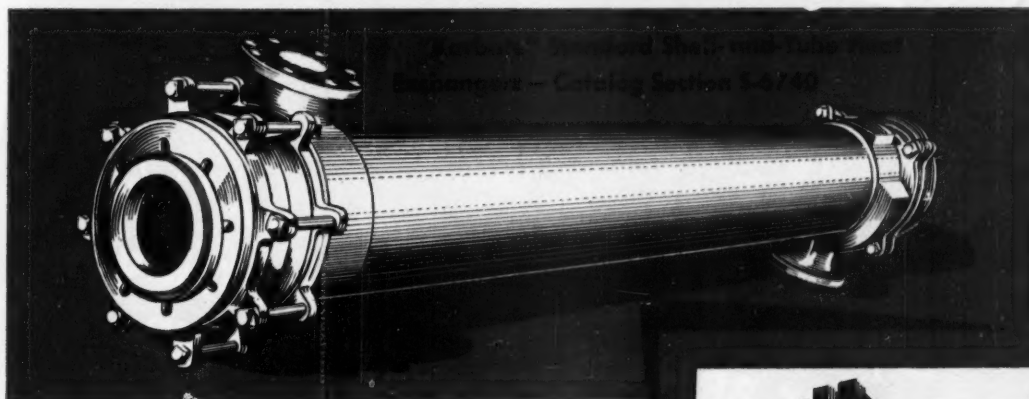
impervious graphite is here applied in pump constructions which will give you years of trouble-free service. Ruggedly built, these pumps stand up under even the toughest conditions, virtually eliminate pump down-time.

WRITE FOR CATALOG SECTION S-7250



...GET "KARBATE"

BRAND
IMPERVIOUS GRAPHITE PROCESS EQUIPMENT



WHEN you select pumping, heat-exchange and conveying equipment, you want the *material* best for the service and a *design* which is simple, rugged and flexible in application.

When you select "Karbate" impervious graphite process equipment, you know where you stand on *both* points—unparalleled corrosion resistance . . . top quality designs.

Add a competent technical service department, ready to help you put these products to work in *your* process, and you know you're set — *with the best!*

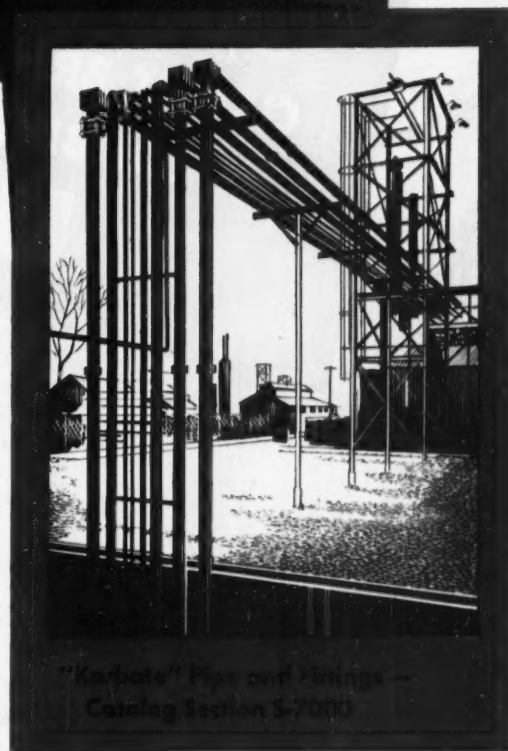
WRITE FOR LITERATURE TODAY!

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

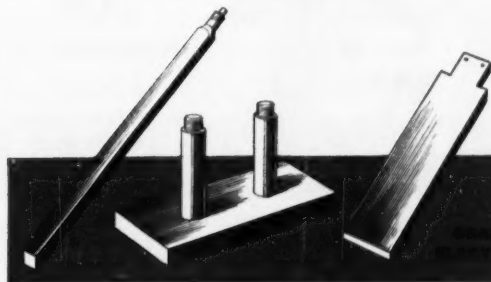
NATIONAL CARBON COMPANY

A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City,
New York, Pittsburgh, San Francisco



"Karbate" Pipe and Fittings —
Catalog Section S-7003



IMPERVIOUS GRAPHITE
KARBATE
PROCESS EQUIPMENT
NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation

ENTIRELY NEW!

Explosion-Proof! Dust-Tight! Rain-Tight! CIRCUIT BREAKER, MOTOR STARTER and COMBINATION MOTOR STARTER **UNILETS**

REG. U.S. PAT. OFF.

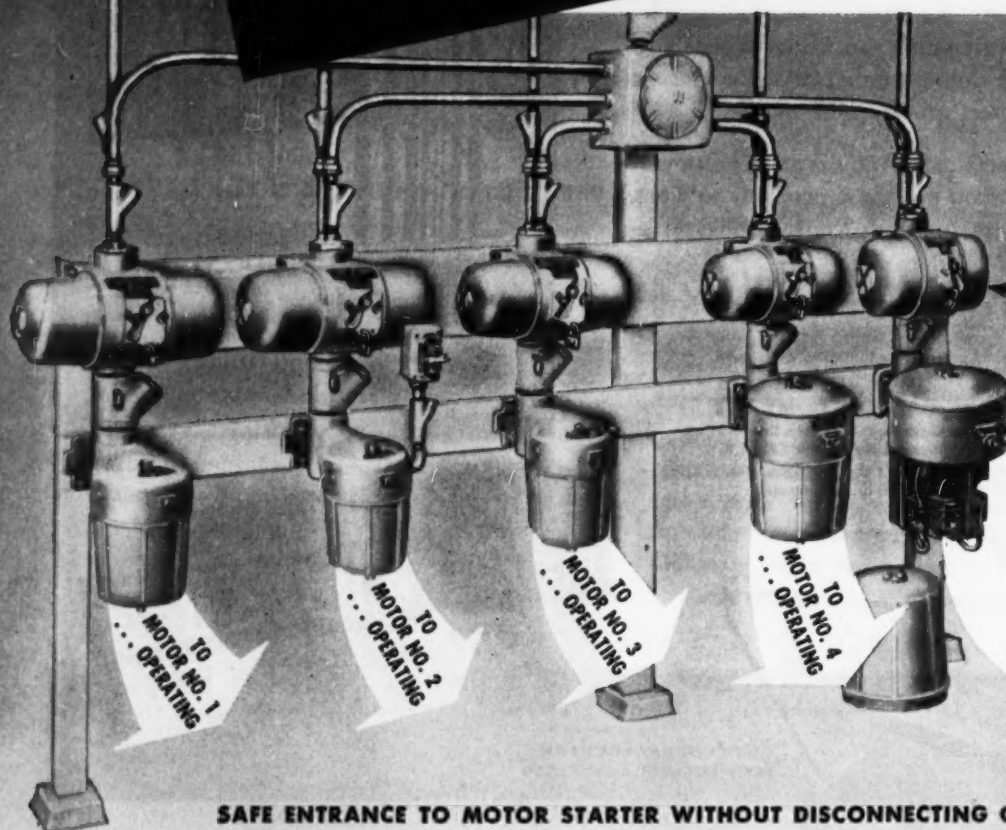


Illustration shows the high safety factor, versatility, and space-saving attributes of *Appleton* explosion-proof circuit breaker and motor starter *Unilet* Combinations. Your own installation needs, no matter what they may be, can also be met with these remarkable new Unilets.

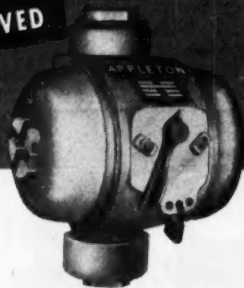
BREAKER LOCKED
IN "OFF" POSITION

MOTOR STARTER
NO. 5 . . .
EXPOSED FOR
SAFE
MAINTENANCE . . .

but no "down time"
on other operating
equipment

**SAFE ENTRANCE TO MOTOR STARTER WITHOUT DISCONNECTING OTHER
BRANCH CIRCUITS . . . ONLY APPLETON UNILETS HAVE THIS FEATURE!**

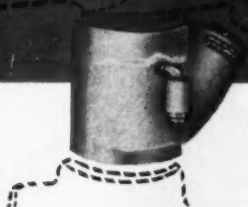
U. L. APPROVED



"CB" Circuit Breaker UNILETS

Assure easy, safe, flexible, and economical installation for protection of service entrance, feeder or lighting, appliance, and branch circuit conductors up to 225 amperes. U. L. Approved individually and in banked groups up to three for forms 1 and 2 without using dividing seal.

U. L. APPROVED



Sealing UNILETS

Available for use as explosion-proof seal where needed on circuit breaker and motor starter Unilets. This Sealing Unilet is furnished on all Combination Motor Starters, and when properly sealed permits safe entrance to a motor starter in single or banked combination installations, without disconnecting other branch circuits.

U. L. APPROVED



"LS" Motor Starter UNILETS

For 3-phase induction motor control up to 100 H.P. at 600 volts maximum. Lightweight construction of larger sizes eliminates need for heavy lift equipment . . . assures easy, time-saving, inexpensive installation. Also made for reversing and two-speed motors.

The greatest advance in explosion-proof design in years!

● You expect more from *Appleton*, and you get it! The proof lies in these completely new and different *Appleton* circuit breaker and motor starter *Unilets*. Alone or in combination, their design, construction, and performance give you maximum safety, unparalleled ease of wiring, installation and maintenance, and initial and long-term money savings not available with any other equipment! You'll find their exclusive features invaluable on any hazardous-location motor control or power lead-in installation, large or small, indoors or outdoors, where tricky wiring, corrosive and flammable atmospheres, dust, or weather difficulties appear insurmountable. Where absolute safety is required day in and day out and every minute of the day, you can place complete confidence in *Appleton Unilets*.

IMPORTANT ADVANTAGES

- **FIRST** to be U. L. Approved for **BANKED** Circuit Breaker Grouping
- **Combinations** Meet U. L. Requirements through Approval of Components
- **FIRST** to Achieve Safe Entrance to Motor Starter of a Combination without Shutting Off Other Branch Circuits
- **Full 7-Thread** Explosion-Proof Protection . . . No Bolts to Strip or Flanges to Nick
- **Unmatched Accessibility** for Easiest Wiring and Servicing on Every Job
- **Light-Weight Construction** for Easy Installation without Heavy Lift Equipment
- **Quick Interchange** on All Leading Makes of Circuit Breakers and Motor Starters
- **Flexible Field Set-ups** Assured with Single and Duplex Male and Female Hub Adapters



BANKED CIRCUIT BREAKER GROUPING

Male to female hubs permit easy grouping. Cuts costs, streamlines panel set-ups, assures coordinated control without sacrificing safety. U. L. Approved up to groups of three in smaller size Unilets.



OVER-SIZE CONDUIT and CONDUCTORS

May be run with hub adapters for subsequent installation of higher rated breakers without replacing complete Unilet or existing conduit.



VERTICAL "STRAIGHT-THRU" DESIGN

Simplifies wire pulling, saves time. Ample working space eliminates need to remove breaker mechanism from enclosure, yet assures clean, safe wiring.

Patent Applied For



PUSH-BUTTON and PILOT DUTY CONTROL

Combines convenience and selectivity including built-in "Start-Stop," "Hand-Off-Auto," or "Jog-Run-Off" control where needed.



Sold Nationally Through Electrical Wholesalers

APPLETON ELECTRIC COMPANY

1742 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Also Manufacturers of:



Explosion-Proof Fixtures



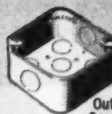
Industrial Lighting



"ST" Liquid-Tight Connectors



Automatic Reelets



Outlet Boxes, Covers, Switch Boxes

Rely on APPLETON . . . The Standard for Better Wiring

WRITE TODAY FOR BULLETIN 12-A

A complete catalog section containing informative technical data.

FASTER
MORE EFFECTIVE...
MORE DEPENDABLE
FIRE-STOPPING
POWER



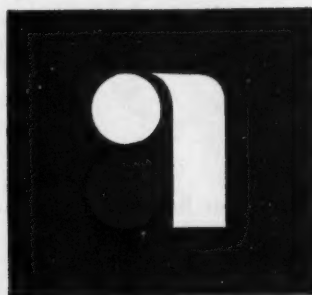
MODEL 20-B



ANSUL

Chemical Company

FIRE EQUIPMENT DIVISION • MARINETTE, WISCONSIN



ANSUL

FIRE EXTINGUISHING EQUIPMENT

FASTER . . . A short, quick downward motion of the puncture lever pressurizes the extinguisher and it is ready for instant use.

MORE EFFECTIVE . . . Even the inexperienced operator gets near-expert results because of the ease of operation and handling. In addition ANSUL "PLUS-FIFTY" Dry Chemical has greater fire-killing power.

MORE DEPENDABLE . . . Exclusive ANSUL-ENGINEERED design features include water-tight and corrosion-resistant construction, easy, on-the-spot recharge without special tools and other exclusive Ansul developments which insure greater dependability.

FIRE-STOPPING POWER . . . ANSUL FIRE EXTINGUISHERS have the highest ratings for fire-stopping power ever awarded any type of class B and C fire extinguishing equipment.



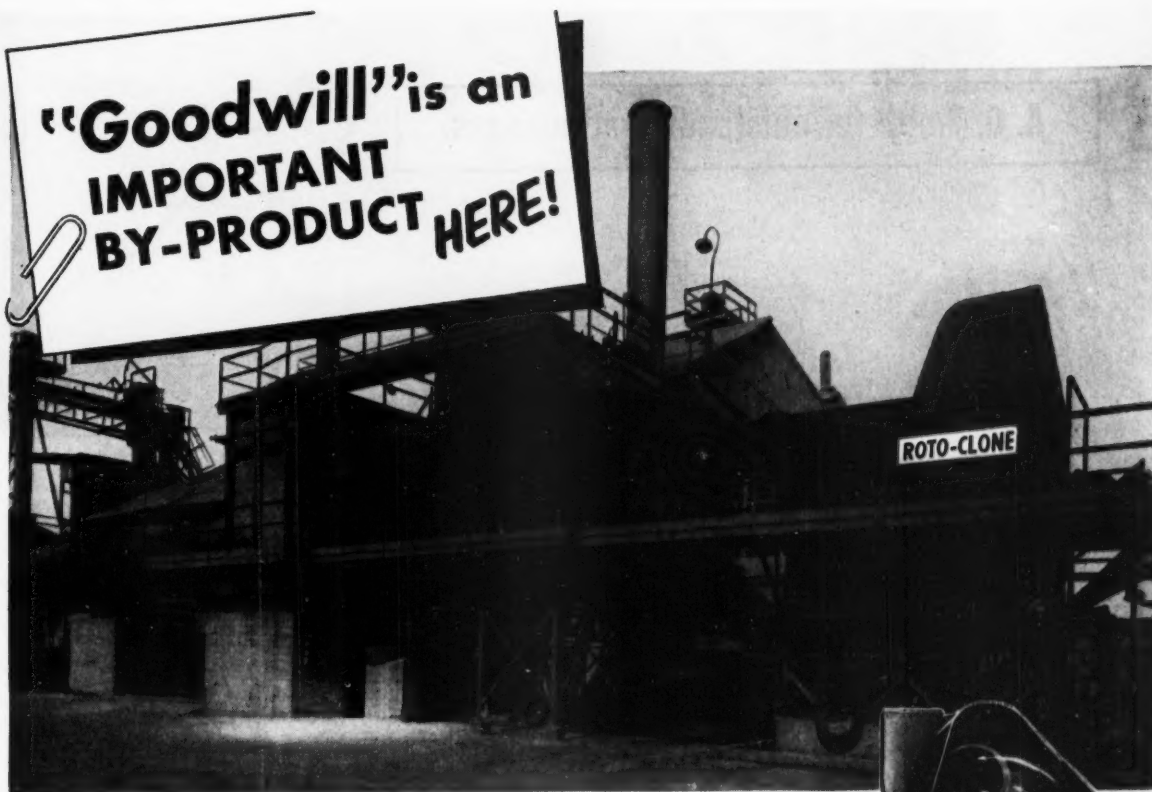
Send for File No. B-202. You will receive a variety of helpful printed matter. Included is our latest catalog which describes Ansul Extinguishers of all sizes — from the small Ansul Model 4 to Ansul Piped Systems and Ansul 2000 lb. Stationary Units.

OFFICES AND DISTRIBUTORS IN PRINCIPAL CITIES IN THE U. S. A., CANADA AND OTHER COUNTRIES

MANUFACTURERS OF
 DRY CHEMICAL FIRE EXTINGUISHING EQUIPMENT, REFRIGERATION
 PRODUCTS, INDUSTRIAL AND FINE CHEMICALS AND LIQUEFIED GASES

February 1954—CHEMICAL ENGINEERING

**"Goodwill" is an
IMPORTANT
BY-PRODUCT HERE!**



Type N ROTO-CLONE ▶

**eliminates stack gas nuisance from
rotary kiln operations at Westvaco Chemical**

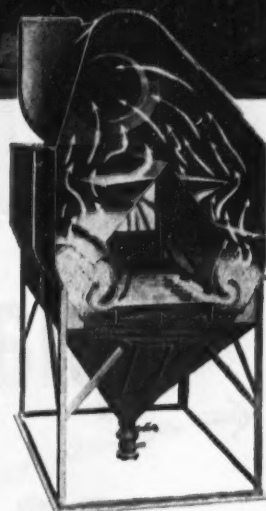
The Westvaco Chemical Division, Food Machinery and Chemical Corp. operates two rotary kilns at its Modesto, Calif., plant for processing barite ore. The larger kiln, pictured above, has a capacity of 70 tons per day—the smaller handles 35 tons. Neither pose a dust problem to plant or community, because both are equipped with a Type N ROTO-CLONE.*

High temperature gases and heavy concentrations of coarse and fine particles are invariably associated with rotary kiln operation—and air pollution problems. And that's where the Type N comes to the rescue! This hydro-static precipitator is unaffected by high temperatures; offers high

collection efficiency on even small micron particle sizes. When bulk of material is needed dry, as at Westvaco, the ROTO-CLONE is an excellent final cleaner to dry type collectors. Small space requirements, constant exhaust volume and reasonable maintenance are other features recommending the Type N ROTO-CLONE for rotary kiln service.

Write for Bulletin No. 277 today! Remember, it costs less to build goodwill than to battle dust complaints.

*ROTO-CLONE is the trade-mark (Reg. U. S. Pat. Off.) of the American Air Filter Company, Inc., for various dust collectors of the dynamic precipitator and hydro-static precipitator types.



Type N ROTO-CLONE with hopper designed for sluicing collected material to process or disposal points.

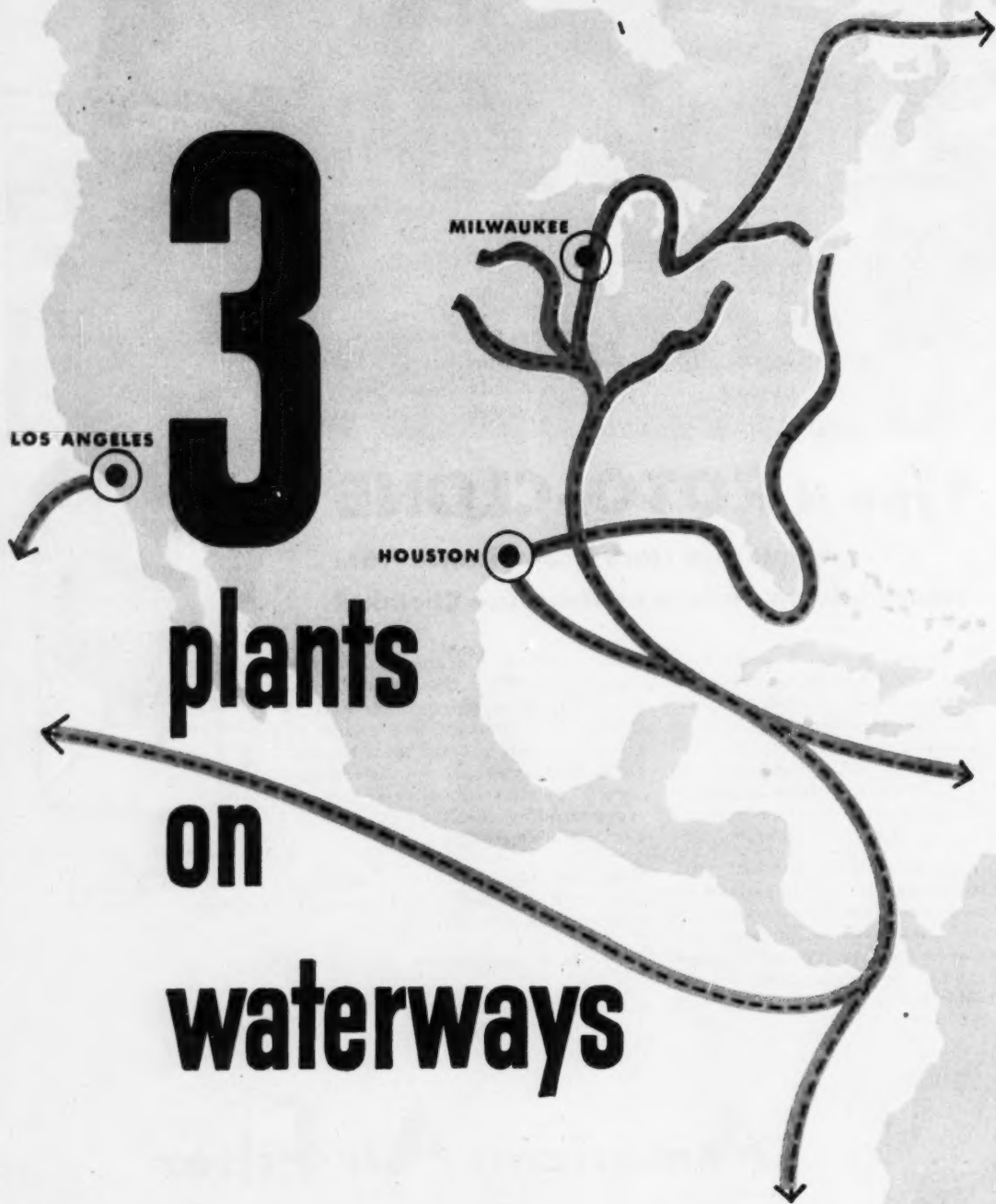


American Air Filter

COMPANY, INC.

326 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

A. O. Smith for outstanding advantages





124,000-pound SMITHlined Coking Drum being loaded on a freighter for direct shipment from Milwaukee to an important refinery in Germany via the Great Lakes-St. Lawrence Seaway to Hamburg. Its dimensions are 14 feet ID, 53 feet length.

Our Milwaukee, Houston and Los Angeles vessel plants are all on waterways providing economical, direct transportation to domestic and foreign ports.

From these plants, direct shipment of the largest pressure vessels and heat exchangers can be made economically. This gives our customers, whose processing plants are convenient to waterways, important advantages and economies.

Their erection problems and expenses are cut considerably when fractionators, converters, accumulators and other large size processing vessels can be delivered in one or, at most, two pieces.

Field assembly costs are avoided or greatly reduced and much time is saved.

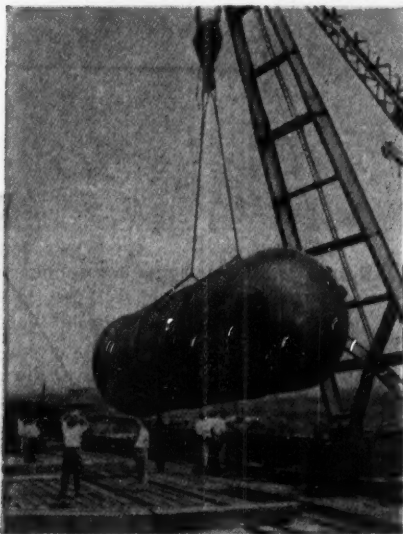
For further information about A. O. Smith pressure vessels, heat exchangers, and the outstanding advantages our customers enjoy, we invite you to write our Milwaukee office.



A.O. Smith
CORPORATION

VESSELS AND HEAT EXCHANGERS

MILWAUKEE HOUSTON LOS ANGELES
International Division: Milwaukee 1, Wisconsin



A 299,000-pound vacuum tower being loaded on a barge for shipment from Houston to New Orleans through the Intracoastal Canal. There, it was loaded on a steamer and shipped to South America. It is 18 feet in diameter, 64 feet in length.



A 320,000-pound SMITHlined Fractionating Tower being unloaded at Whiting, Indiana. It was barged down Lake Michigan from Milwaukee. It is 16 feet in diameter, 107 feet in length, and shop-fabricated in one piece to avoid costly field assembly before erection at the refinery site.

Pioneers in **HOMOGENEOUS LEAD BONDING** *First Again with a "NEW MECHANICAL" Bonding Process*

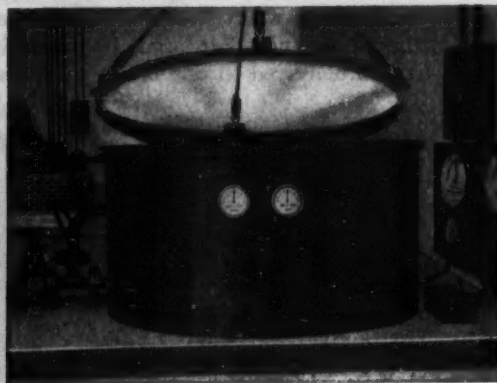
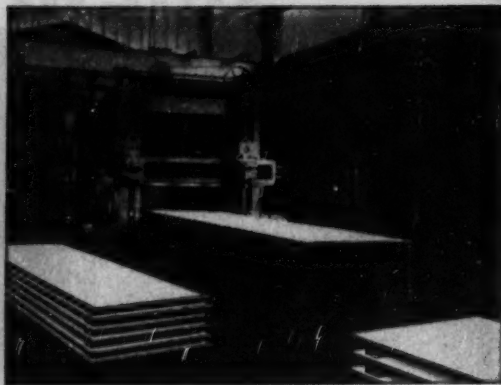
*Our newly developed "mechanical" process for applying **Homogeneous Lead Bondings** affords you a considerable saving in both delivery time and cost over the slower "hand-burning" method.

We suggest that you pay a visit to our plant and view this newly developed "Mechanical" cost-saving lead bonding process. Our Engineers are available for consultation without obligation. Your inquiries are solicited.



Homogeneous Lead Bondings are applied to any thickness of shell plates in the flat before shaping to your specifications. Plates as large as 10'-0" x 20'-0" are easily handled on our new unit, thus eliminating many unnecessary weld seams. Outlets and connections are Homogeneously Bonded regardless of size.

To insure uniform over-all thickness of the Homogeneous Lead Bondings and eliminate the human errors occurring in other methods, lead is applied "oversize" to flat sheet plates and then planed to required thickness. In addition, this operation affords considerable savings in time over the general "Hand Scraping" method.



Dished Heads of all types and various irregular shaped pieces of equipment are Homogeneously Lead Bonded in our Special "MECHANICAL" Unit. Here again, considerable saving in time and cost is effected over the general method.

KELLEY Custom-Built for the Processing Industries



O. G. KELLEY & CO.
ENGINEERS DESIGNERS FABRICATORS

96 TAYLOR STREET, BOSTON 22, MASS.

CLEVELAND, OHIO

JOHNSON CITY, TENN.

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HOUSTON, TEXAS

PITTSBURGH, PA.

ELIZABETH, N.J.

TANKS · LEAD COILS · LEAD & LEAD LINED VALVES
 SHEET LEAD LININGS · CASTINGS & FITTINGS

Do You Have Trouble Processing

- SOLIDS ?

- SLUDGES?

- PASTES ?

Here is a unit designed and built by Bethlehem to recover a valuable solvent from a sludge which set up during processing. All other methods tried proved unsuccessful.

Bethlehem Kettle
for solvent
recovery

SPECIAL FEATURES of design were:

- THERMOCOIL construction (see insert) to accommodate high pressure of 450 steam, as well as high circulation rate of cooling water.
- Rugged agitator system to break up and circulate material as it sets up as well as scrape vessel wall to maintain good heat transfer.
- Agitator arms and blades protected to provide required abrasion resistance.
- Selection of cast iron vessel, to provide combination of corrosion resistance and property of non-galling against scraper action.

BETHLEHEM has developed many other units

—For recovering products from difficult to handle sludges.

—For reaction between gases or liquids with difficult to handle solids or pastes.

For your processing requirements involving solids and semi-solids, we offer you the service of our engineers who have the chemical, mechanical, and metallurgical background demanded for many such difficult processing problems.

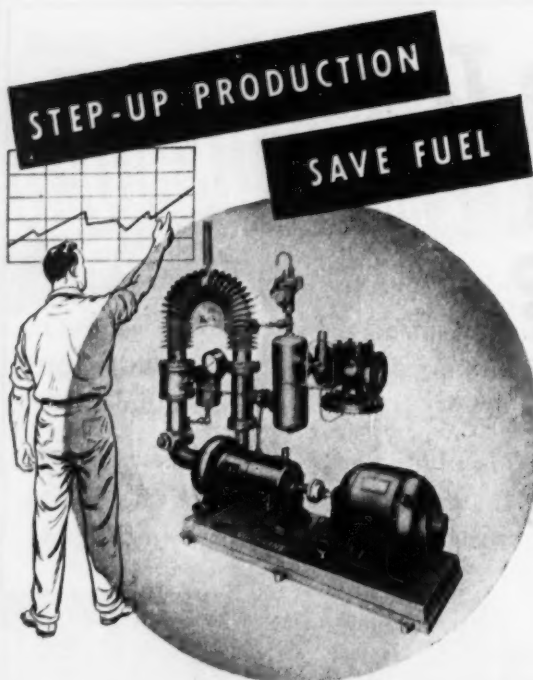
Detail of Bethlehem
cast-in-wall Thermocoil arrangement
for demanding heat transfer requirements.

BETHLEHEM FOUNDRY & MACHINE CO.

BETHLEHEM

PROCESS EQUIPMENT DIVISION

PENNSYLVANIA



Install a Cochrane C-B

CONDENSATE DRAINAGE CONTROL SYSTEM

Over 1700 installations in plants of blue-chip companies processing with steam prove it will do the job better. (Names and case histories on request.)

Faster Heat—quick, thorough removal of air and condensate

Higher Temperature—faster, more intense heat transfer

Uniform Heating—fluctuations leveled-out, cold spots eliminated, product quality improved

Lower Maintenance—corrosive gases and entrained air automatically removed from returned condensate.

The Cochrane "JET" Unit removes "insulating" layers of condensate continuously and efficiently from all types of steam processing equipment . . . shortens cooking and drying cycles . . . provides more intense latent heat transfer, which has resulted in production increases up to 35%.

And by returning condensate to the boiler without appreciable pressure or temperature drop, savings in fuel costs of 1% for every 11° rise in water temperature are achieved . . . in some cases as high as 20%. Make-up water cost and requirements decline sharply. No water lost through flashing.

Consult us on condensate drainage and recovery problems—The C-B (condensate booster) may be the answer that will increase the over-all efficiency of your operations. Write today for Pub. 3250 containing detailed information. Let us prove to you that the "JET" principle does produce results.



cochrane

corp. 3113 N. 17th Street, Philadelphia 32, Pa.

Representatives in Principal Cities in U.S.A.

In Canada: Canadian General Electric Co., Ltd., Toronto

In Mexico: Babcock & Wilcox de Mexico, S.A., Mexico City

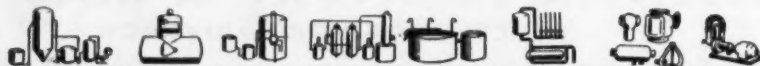
In Europe: Recuperation Thermique & Epuration, Paris

In Cuba: Laurence E. Daniel, Inc., Havana

In South America: Servicios Electricos, C.A. (S.E.C.A.) Caracas, Venezuela

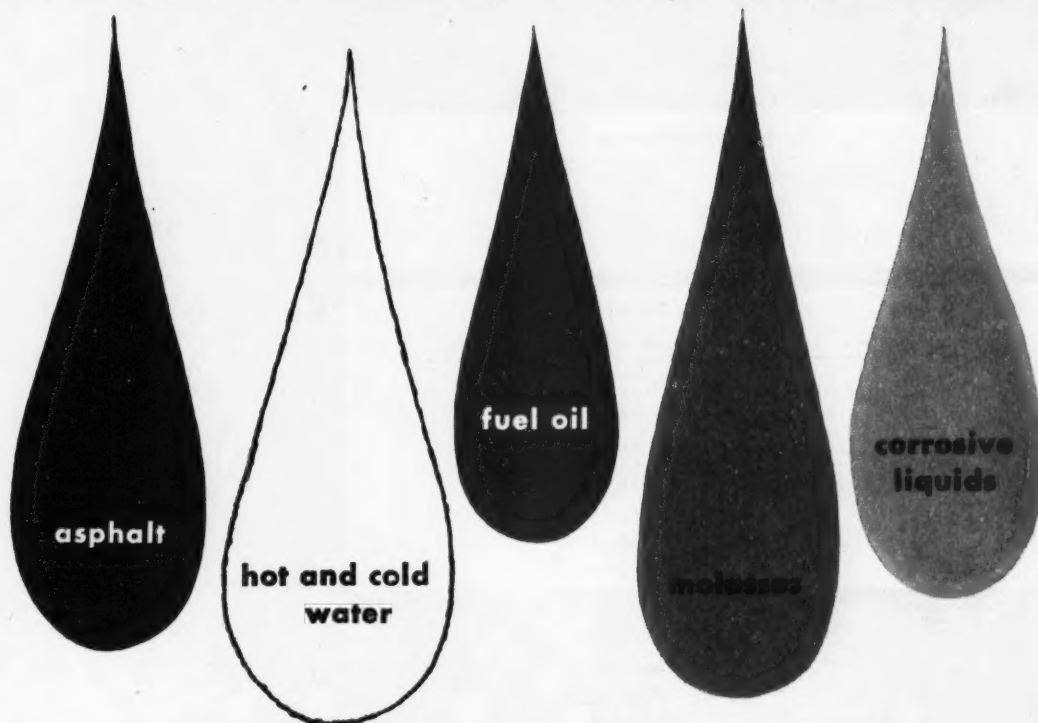
In Puerto Rico: F. A. Ortiz & Co., San Juan 5

In Hawaii: The Hawaiian Electric Supply Company, Honolulu



Hot Process Softeners • Deaerators • Dealkalizers • Demineralizers • Reactors • Continuous Blow-Off • Specialties • C-B Systems

viscosities unlimited



HAYS VERIFLOW METER AND HAYS ELECTRONIC VERITROL

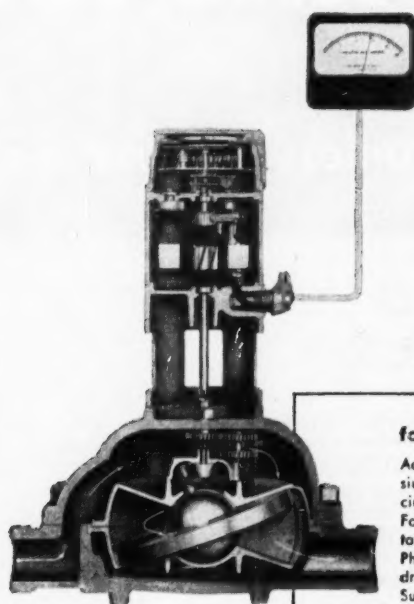
indicate and control liquid flow

Now virtually all fluids can be precisely measured and accurately controlled—from a remote position.

Hays VERIFLOW meter accurately measures, indicates, and totals the flow of corrosive and hard-to-meter liquids without using weigh tanks, orifice plates, or gage sticks.

With the Hays VERITROL you simply set a knob at the rate of flow desired . . . then, the VERITROL controls the flow of liquid at that set-rate.

Send for a complete description of Hays Veriflow Meter and Veritrol, Pub. No. 53-766-38.



for corrosive liquids

Acetic Acid, Aluminum Potassium Sulphate, Ammonia, Calcium Compounds, Carbolic Acid, Formaldehyde, Fruit and Vegetable Juices, Hydrogen Peroxide, Phosphoric Acid, Potassium Hydroxide, Sodium Compounds, Sulphuric Acid (concentrated), Stearic Acid, and many others.

Automatic Combustion Control
Boiler Panels • Hays-Pern Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO₂ Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE
hays
CORPORATION

MICHIGAN CITY, 9 INDIANA

Typical Fillet Speeds

Electrode Size	Amps., AC	Fillet Size	Speed, in./min.
$\frac{3}{16}$ "	290	$\frac{1}{4}$ "	15
$\frac{7}{32}$ "	325	$\frac{3}{16}$ "	15
$\frac{1}{4}$ "	395	$\frac{3}{8}$ "	15

Deposition Rates

DH-5		E-6012	
Electrode Size	Amps.	Deposit #/hr.	Deposit #/hr.
$\frac{3}{16}$ "	250	6.8	4.5
$\frac{3}{16}$ "	280	7.9	
$\frac{3}{16}$ "	320	9.6	
$\frac{7}{32}$ "	300	9.0	5.8
$\frac{7}{32}$ "	340	10.1	
$\frac{7}{32}$ "	380	12.0	
$\frac{1}{4}$ "	350	11.2	7.0
$\frac{1}{4}$ "	400	12.8	
$\frac{1}{4}$ "	450	14.7	

Try to match this for

You can't — unless you use the . . .

Deposits up to twice as many pounds per hour as an E-6012

That's right, the DH-5 is in a class by itself, when it comes to high welding speed and sound deposits in horizontal and flat positions. It's Harnischfeger's answer to the demand for lower welding costs. It's your answer to the need for faster, better work.

Powdered metal in the coating becomes part of the deposit — increases thermal energy and efficiency. By simply dragging the DH-5, the operator gets the speed and bead appearance ordinarily associated with submerged arc welds.

Wherever they've tried it, weldors like the DH-5. It's fast, it's easy to use. There's no splatter. Slag removal is easy and quick. The bead shape is flat and smooth.

The DH-5 has good, as-welded, mechanical properties, too. See for yourself:

Tensile strength	- - -	85,000-95,000
Yield strength	- - -	73,000-77,000
Elongation in 2"	- - -	15-25%

If you're interested in your cost picture — and who isn't, today?—you owe it to yourself to try the DH-5 without delay. See your P&H representative or distributor now.

For further facts, write for bulletin.

P&H WELDING DIVISION
HARNISCHFEGER
CORPORATION
 4487 WEST NATIONAL AVE. • MILWAUKEE 46, WISCONSIN

the **P&H** Line





high-speed welding!

New P & H DH-5 Electrode

America's most complete line of
arc-welding equipment and electrodes



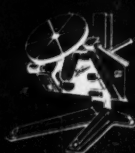
P & H DC RECTIFIER WELDER

Four sizes — 200, 300, 400 and 500 amps (NEMA-rated). No moving coils to break down — no bearings, brushes, commutator, brush riggings, etc. to replace. Dial-electric Control gives you fingertip heat-control at the work.



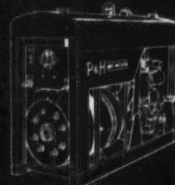
P & H AC WELDER

A full range of sizes up to 625 amps (NEMA-rated). All are connectable to 220 or 440 volts. Dial-electric Instantaneous Remote Control is fingertip control — gives you any heat you want, right at the work.



P & H POSITIONERS

One finger is enough to position heavy weldments for economical downhand welding. Capacities from 2500 to 36,000 lbs. — remote-control and hand-operated models.



P & H WN-250 ENGINE-DRIVEN ARC WELDER

NEMA-rated at 200 amps, but pulls 300 amps. Has full 20-gallon gas tank — runs all day on one tankful. Powered by four-cylinder, 180 GLU, Waukesha, water-cooled gasoline engine.

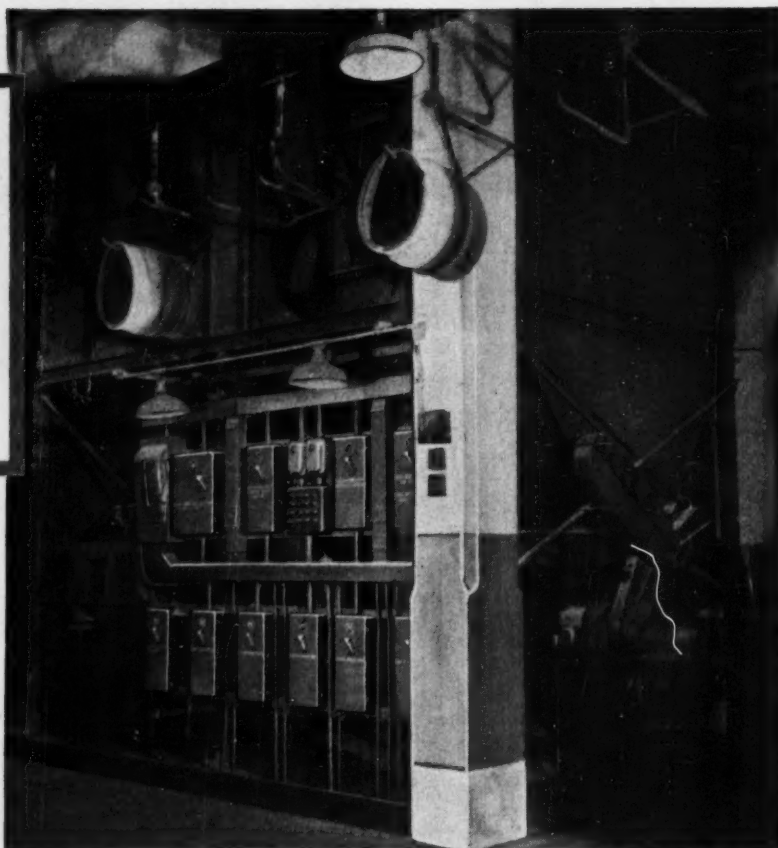
P & H Welding equipment is manufactured and sold in Canada by
REGENT EQUIPMENT MANUFACTURING COMPANY LTD.
455 King Street West • Toronto, Ontario, Canada



THE SIGN OF QUALITY
IN MOTOR CONTROL

Dracco

**multibag
dust arrester**



Machine is used for collecting dust from an automatic tire-dusting machine and returning the dust into process. Note the numerous Allen-Bradley controls

... equipped with ALLEN-BRADLEY TROUBLE FREE COMBINATION MOTOR STARTERS



Bulletin 712 Automatic Combination Starter in a NEMA Type 12 Enclosure for protection against dirt and oil.



Here are the "Plus Values" which you obtain "free" when you install Allen-Bradley solenoid control:

1. The simple, time-tested, and maintenance free design is your guarantee of millions of trouble free operations.
2. The straight up-and-down motion of the solenoid plunger is frictionless—it cannot "stick" closed.
3. There are no troublemaking pins, pivots, bearings, or intricate linkages to corrode and fail in operation to cause annoying trouble.
4. Allen-Bradley double break, silver alloy contacts require no maintenance.

For reliable day-in and day-out control performance, it will pay you to specify Allen-Bradley controls—they're Quality control.

Incidentally, enclosures are available for every operating condition.

Allen-Bradley Co., 1337 S. First St., Milwaukee 4, Wis.



—Here are some more features that distinguish Allen-Bradley Starters.



Maintenance Free
Double Break
Contacts



Reliable Motor
Overload
Protection



Easy to Install,
White Interiors,
"Bonderized"



Easy to Add
Auxiliary
Contacts



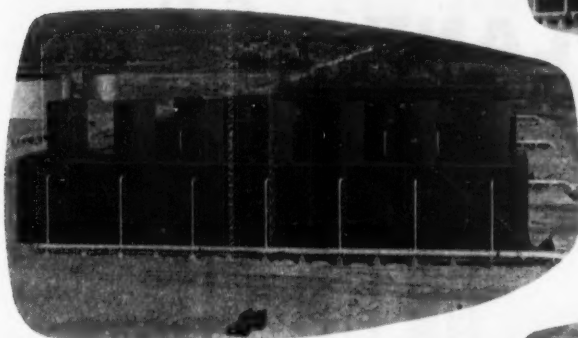
Safe Enclosures
for all
Applications

ALLEN-BRADLEY

SOLENOID MOTOR CONTROL

QUALITY

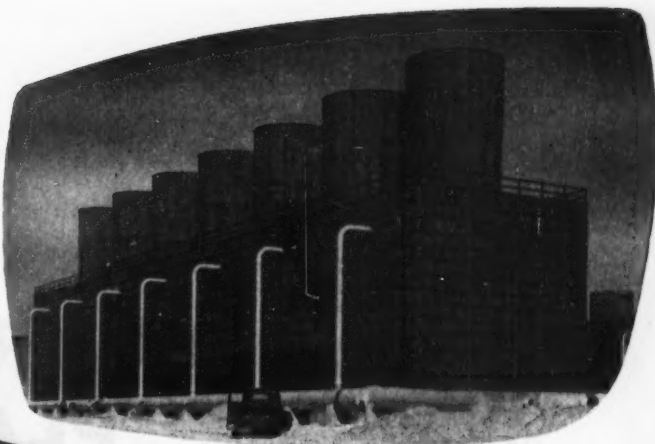
FLUOR is building
the world's largest initial
cooling tower installation



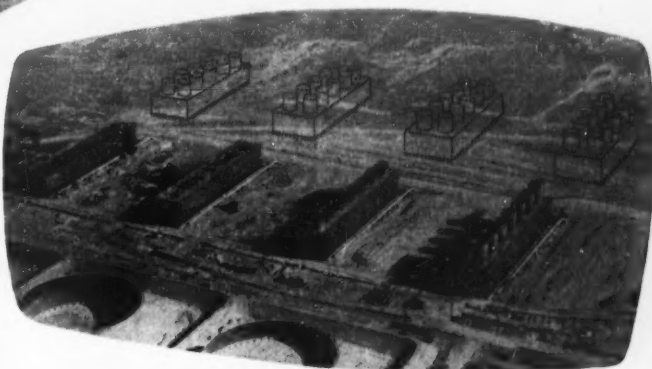
The power plant itself is the largest initial installation inland and is being constructed in two sections. The first section consists of two units of 100,000 KW each, the second section of two units of 156,000 KW each. The four Fluor towers shown here (28 cells) in progressive stages of erection, are designed at 36,000 g.p.m. each, with a maximum of 42,000 g.p.m. They will service the first section of the plant. Design cooling range is 14° F with water entering at a temperature of 95° F and leaving at 81° F. The design wet bulb temperature is 70° F. Heat load is 1 billion B.t.u./Hr. for the first four towers.

Each cooling tower is 250 ft. long, 42 ft. wide and 37.5 ft. high to the fan deck. Twenty-foot, four-bladed fans are driven by 40 H.P. motors. Each fan moves 436,000 CFM. Capacity rating is 144,000 g.p.m. through a low pressure water distributing system. A distinctive feature of these towers is the Fluor-designed redwood stack standing 30 ft. high to minimize recirculation at peak load conditions.

Ground has been broken for the erection of four additional Fluor towers to serve the second section of the plant. Each tower will consist of 5 double-cells for a total of 40, with water circulation of 136,800 g.p.m. Design duty: inlet temperature 101° F, outlet 80° F, wet bulb 70° F. Heat load is 1,440,000,000 B.t.u./Hr. Dimension of these towers: 180 ft. long, 66 ft. wide, 45 ft. high to fan decks. Fans (18 ft.) will be driven by 40 HP motors and each will move approximately 350,000 CFM.



These Fluor Counterflo Cooling Towers are now being erected in the San Fernando Valley at the site of the new 512,000 KW steam-electric generating plant for the Department of Water and Power, City of Los Angeles. They comprise the largest initial cooling water circulating system utilizing cooling towers ever built.



In addition, an auxiliary system (the bearing cooling water) employs a 4-cell Fluor Tower with a heat load of 40 million B.t.u./Hr.

When completed, total cooling water circulation will exceed 280,000 g.p.m. and will circulate over 240 miles of condenser copper tubing. Total heat load will approach 2½ billion B.t.u./Hr. The big jobs can be entrusted to Fluor, a firm with 33 years experience in the design and manufacture of cooling towers for every type of service. For complete details on Fluor Cooling Towers, write for the new illustrated bulletin, "Cooling Water for Industry."

BE SURE WITH

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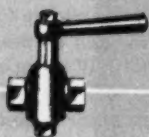
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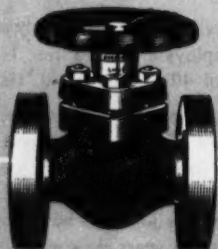
COCKS



GAGES



VALVES



INSTALL



Klinger

FITTINGS

Write for the Klinger Master Catalog which describes the complete range of Klinger products, compressed asbestos sheet packings for all ports, valves, cocks, level gauges, synthetic and asbestos rollers.

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No Room for Industrial Complacency

Do you believe that American industry is equipped with remarkably up-to-date and efficient machinery? If you do, you are mistaken. The fact is that a large share of American industry's equipment is ancient, of obsolete design and incapable of attaining the efficiency that is made possible by modern production techniques.

This fact is documented by the Seventh Inventory of Metalworking Equipment, just completed by **AMERICAN MACHINIST**, a McGraw-Hill publication. In brief, **AMERICAN MACHINIST** shows that:

1. More than half (56%) of American industry's most basic production equipment—machine tools and metal-forming units—is overage, and much of it is so old that it has very limited usefulness.

2. Since Korea, the situation has become dangerously worse.

Facts vs. Plausible Theory

These conclusions contradict the widely-held

impression that America's industrial equipment is in better physical shape than ever before. The prevalence of this impression is not surprising. We, as a nation, have spent about \$125 billion for new industrial plant and equipment since World War II. That is more than in any previous period in our history. During 1953, American industry invested \$21 billion in new plant and equipment, an all-time high. From this, it would be reasonable to infer that our industrial plant and equipment must be in fine condition.

But the facts do not support that inference with respect to the machine tools and other metalworking equipment that are so crucial to our economy in war and peace. Here are the key findings of the **AMERICAN MACHINIST** Inventory:

- (1) More than one million machine tools—out of a total of less than two million in the metalworking industries—are at least ten years old. Many of these, after day and night operation

during the war years and the recent rush to rearm, are actually much older production-wise than their age in years indicates. In most cases, these machines are unable to produce goods as efficiently as modern equipment can, thus needlessly increasing costs.

(2) Almost one out of five machine tools is more than twenty years old. Most of these machines are so outdated by modern standards that they have little more than scrap value. And an even larger portion of our metal-forming equipment (presses, brakes and shears, bending and straightening machines) has passed the 20-year mark and is beyond normal retirement age.

(3) Two out of three machine tools are of designs predating World War II, though many of them have been built since the war. Thus, two-thirds of our machine tools fail to incorporate the many major postwar improvements in design and operating methods.

(4) Never before has outmoded high-cost equipment been so widely diffused throughout American industry. In every one of fifteen major divisions of metalworking production, more than 45% of the machine tools are at least ten years old.

(5) Not since the depression days of the 1930's has the average age of machine tools risen so rapidly as it has in the past four years. Today, 55% are ten years old or older, compared with 43% just before Korea.

Quality vs. Quantity

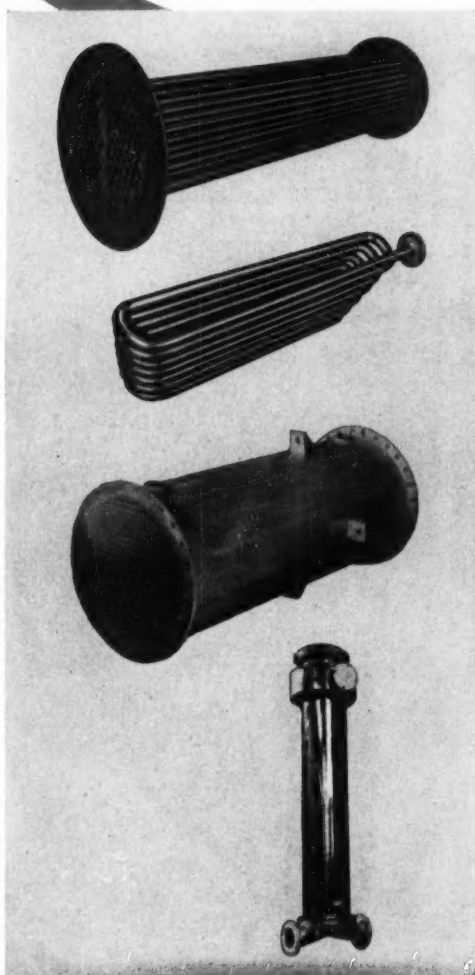
Why has the condition of our metalworking equipment been steadily deteriorating since the end of World War II? Part of the explanation lies in the fact that, in the immediate postwar years, production of metalworking equipment lagged behind the production of industrial equipment generally. The larger part of the explanation, however, lies in the tremendous postwar expansion of the American economy. This expansion, which has more than doubled our total industrial capacity, has imposed requirements for metalworking machinery that have been met only by more extensive use of old and obsolete tools. In the critically important field of metalworking, the job of providing up-to-date tools is bigger than it ever has been.

There are those who argue that the time has come to cut back investment in new industrial plant and equipment and divert more of the national income into current consumption. They cite both the great increase in the nation's total industrial capacity since World War II and the fact that some industries now have more than ample producing capacity to meet their needs. But this type of calculation leaves out the *efficiency* of that producing capacity.

The AMERICAN MACHINIST Inventory makes it manifest that in the key field of metalworking we are alarmingly short of first-rate, low-cost producing capacity. If we fail to remedy this situation by speeding the replacement of obsolete tools, it will be at the peril of our prosperity, at the peril of a sustained increase in our standard of living and of our national security.

McGraw-Hill Publishing Company, Inc.

When the Heat's On*
Exchangers Stay on the Line LONGER
... with Carpenter Stainless Tubing



At the left are pictured a group of heat exchangers and heaters in service on widely diverse jobs, in all parts of the country. They have one thing in common—the Carpenter Stainless Tubing that keeps them on the line longer—*when the heat's on for production.

Modern process equipment like this has to stay on the job. You can't afford to interrupt a process for hours or days to replace tubes.

That's why—after considering many sources—more and more orders call for Carpenter Stainless Tubing. They know that the quality standards we set at the mill will safeguard the quality reputation of their equipment.

Analysis, Tolerance and Finish are guaranteed to be "as ordered" on every shipment of Carpenter Stainless Tubing.



Send for this USEFUL SLIDE CHART

Physical properties, sizes and gauges, cross-sectional areas, velocity constants, pressures, weights and other technical data on Carpenter Stainless Tubing for heat exchanger applications are condensed into this handy chart. It's yours for the asking, on your company letterhead.

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.
"CARSTEELCO"

Carpenter

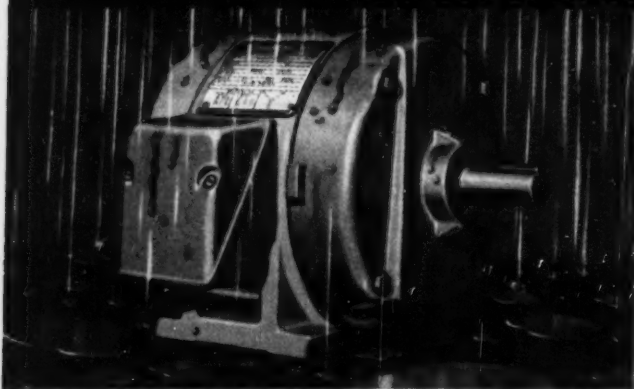
STAINLESS TUBING & PIPE



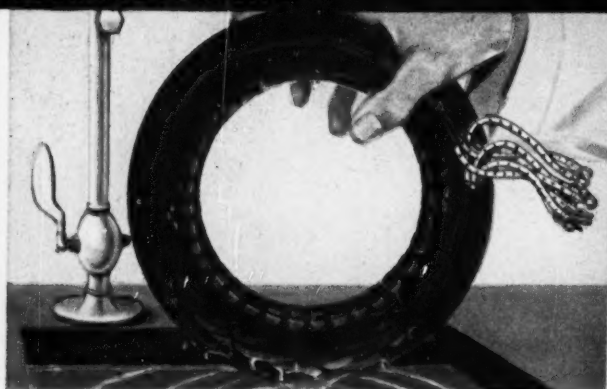
- guaranteed on every shipment



YOU GET EVEN LONGER MOTOR LIFE



PHYSICAL PROTECTION INCREASED 60 PER-CENT by a complete re-design of cast-iron frame and end shields. This motor is suitable for many jobs where ordinary dripproof motors should not be applied.



EXTRA ELECTRICAL STRENGTH is assured by use of new polyester film insulation. A silicone coating, Dri-film,* virtually eliminates stator insulation failure caused by moisture.

*REG. U.S. PAT. OFF.

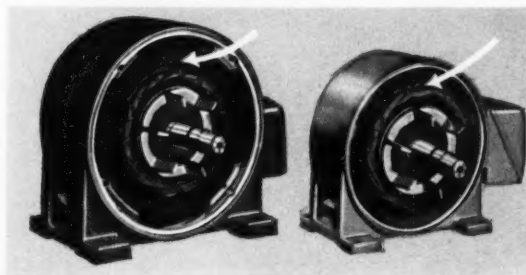
TRI-CLAD

THE LEADER IN MODERN MOTOR DESIGN

GENERAL ELECTRIC ANNOUNCES...

THE ALL-NEW **TRI 55 CLAD** MOTOR

REG. U.S. PAT. OFF.



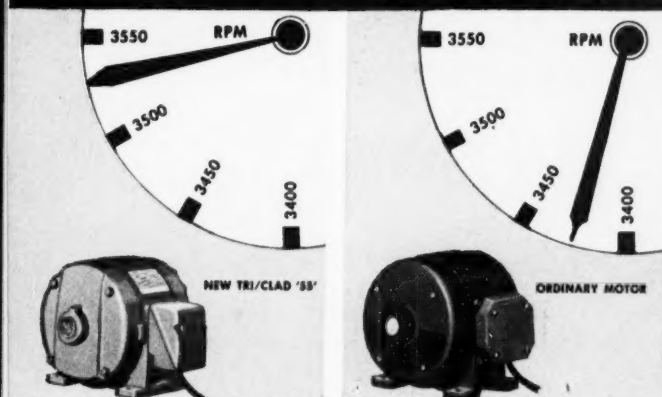
LIGHTER, SMALLER Tri/Clad '55' motors have been made possible through better use of space within the frame. Active materials (magnetic steel, copper) have not been sacrificed.

Complete Line of Drip-proof, Enclosed Motors and Gear-Motors Available in Most Ratings in 1954

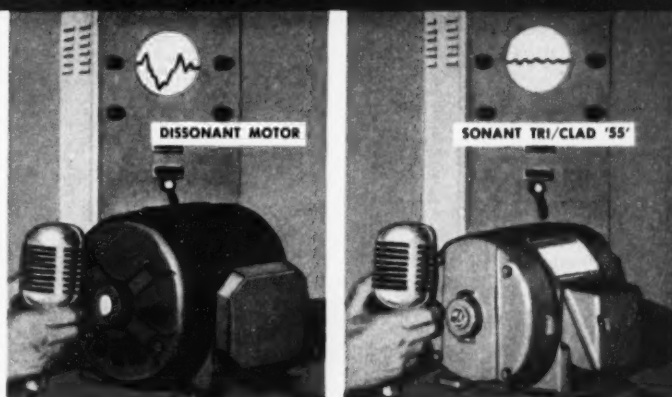
Here's the all-new Tri/Clad '55' motor — now available in NEMA 132 and 184 frame sizes.

You can get complete information on this dramatic motor achievement by writing for bulletin GEA-6013 on Tri/Clad '55' Drip-proof motors, GEA-6012 on Tri/Clad '55' Enclosed motors, or GEA-6027 on Tri/Clad '55' Gear-motors, or by contacting your nearby G-E Apparatus Sales Office or G-E Motor Agent. General Electric Company, Section 648-1, Schenectady 5, N. Y.

YOU GET EVEN BETTER PERFORMANCE



HIGHER FULL-LOAD SPEEDS is only one of many improved characteristics of this new G.E. motor. Above shows comparison of an ordinary motor with the Tri/Clad '55' — both rated at 3600 rpm.

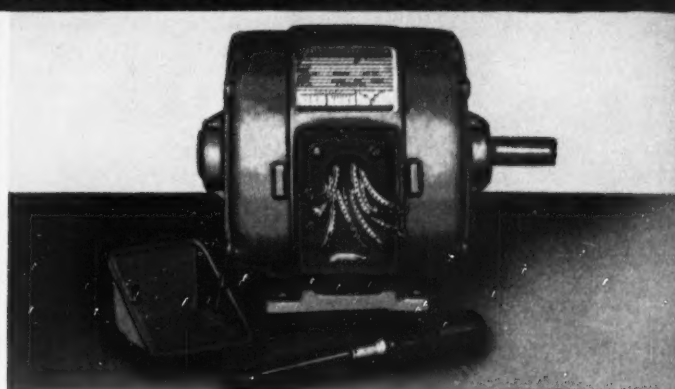


SONANT OPERATION of the new Tri/Clad '55' motor has been laboratory tested and proven. Motor operates at reduced noise level, and operating sound is pitched to a more pleasant frequency.

YOU GET EVEN MORE INSTALLATION AND MAINTENANCE SAVINGS



NEW BEARING SYSTEM allows this motor to run longer than other motors without regreasing. One reason—greatly improved synthesized grease with 8 times the mechanical stability of ordinary grease.



EASIER TO SERVICE, the new Tri/Clad '55' has larger conduit box diagonally split for simplified wiring. Perma-numbered leads mean that even clipped and stripped wires are instantly identified.

Progress is our most important product

GENERAL  ELECTRIC



**"Diatomite
you say -
where?"**

Mister, you're surrounded by things containing diatomite, or which were filtered by it. That beer you're delivering owes its brilliance and clarity to diatomite filtration. The paint on your truck has likely been extended with diatomite. Your battery may have diatomite as a filler in the case or separators. And diatomite helped in several ways to produce the oil which lubricates your truck motor.

In any of these cases, mister, it's a better-than-even bet that the diatomite used bore the name DICALITE — because DICALITE is top-quality diatomite, processed for many uses to the highest quality standards ever established. Food processors use DICALITE filteraids to

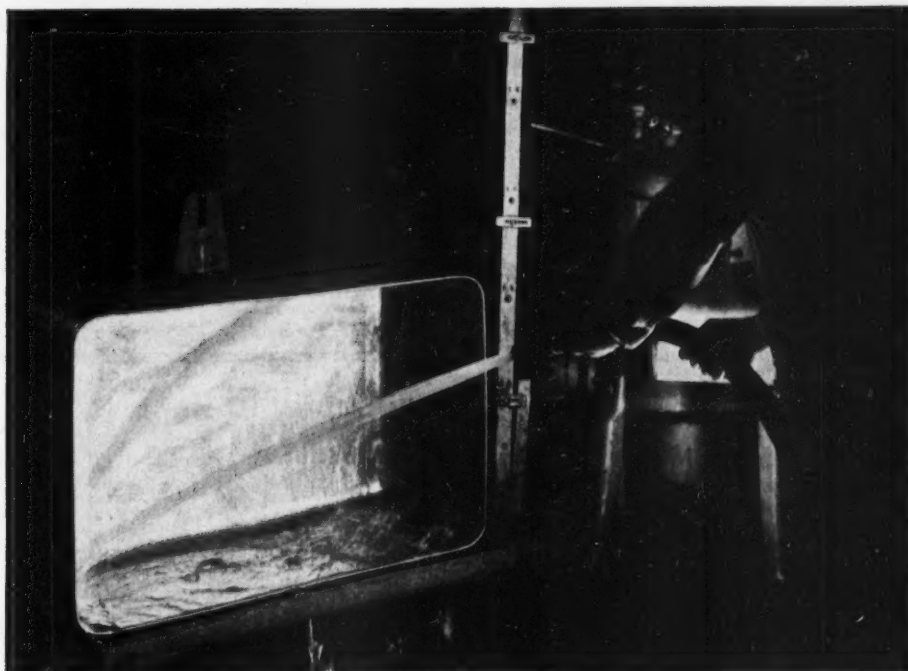
produce sugar, shortening, salad oils, jellies and other good things on the shelves of that market. DICALITE plays a vital role in producing streptomycin and other antibiotics, vitamins and other pharmaceuticals. The dry-cleaner uses DICALITE products to keep his cleaning solvent clear and active . . . there's DICALITE in the magazine pages on the news stand and in those beer cartons — and perhaps even in the asphalt under your feet and in the concrete of the building.

So varied are the uses of this versatile material, nobody yet knows them all. If you'd like to learn more, let us send you a bulletin on DICALITE filteraids, fillers, insulation, or other aids to industry.

Write to Dicalite
Division, Great Lakes Carbon
Corporation, 614 So. Flower St.,
Los Angeles 17, California

Dependable
GREAT LAKES **Dicalite**[®]
DIATOMACEOUS MATERIALS

NEW YORK 17 • CHICAGO 1 • LOS ANGELES 17



ENDURO PROCESS EQUIPMENT CLEANS AS EASILY AS THIS



He's washing down a blow-pit drainer bottom. It's made of stainless steel to forestall corrosion and maintain cleanliness of acid solution.

● The ease with which this ENDURO Stainless Steel container is cleaned will interest everyone who operates metal equipment. As is the case here, a simple warm water rinse usually restores ENDURO surfaces to sparkling cleanliness. Occasionally, some more stubborn materials may require brushing or the use of stronger cleaning compounds. Not often.

What makes ENDURO so remarkably easy to clean and to keep clean? It is solid stainless steel, with no applied surface to chip, peel or crack. It is strong, tough, durable. Takes quite a knocking around without coming up dented or abraded. It resists rust and corrosion, and the action of most acids and alkalis. Result: ENDURO equipment presents a smooth, hard surface. Residue and contaminants have little foothold. They flush away.

Think what this ease of cleaning can mean . . . in man-hours saved . . . in greater utilization of equipment . . . in fast change-over . . . in protection against product spoilage . . . in greater earning power. Ask your equipment supplier, or write Republic for help in applying ENDURO Stainless Steel to your process equipment needs.

REPUBLIC STEEL CORPORATION

Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Dept.: Chrysler Bldg., New York 17, N.Y.



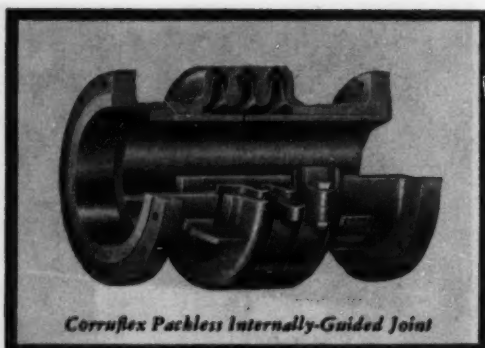
ENDURO STAINLESS STEEL

Other Republic Products include Ex-L-ite Tin Plate, Pipe, Sheets, Bolts and Nuts, Electrinite Tubing, Steel Barrels and Drums

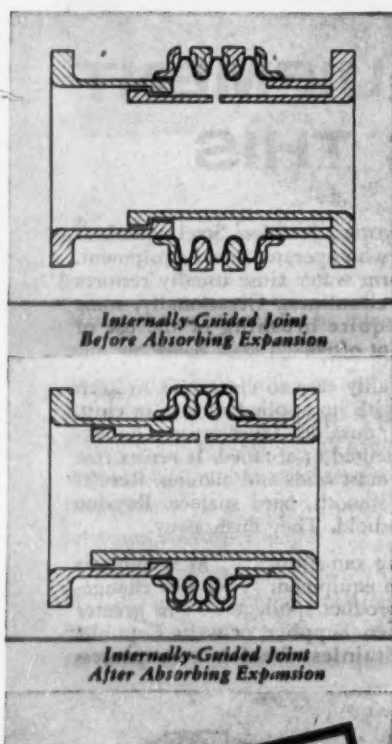
MASTERPIECE

OF **ADSCO** ENGINEERING

Corruflex INTERNALLY-GUIDED EXPANSION JOINT
 PROVIDES RIGIDITY IN SPECIAL PIPING PROBLEMS



Corruflex Packless Internally-Guided Joint



*Internally-Guided Joint
 Before Absorbing Expansion*

*Internally-Guided Joint
 After Absorbing Expansion*

One of many reasons why Corruflex Packless Expansion Joints are so widely used by progressive engineers is the completeness of the Corruflex line. There is a Corruflex joint to absorb pipe expansion under *any* piping condition.

Suppose an engineer wants a joint which provides rigid construction against all movement except axial movement. ADSCO has the perfect solution — the Corruflex Internally-Guided Expansion Joint. No maintenance required because it is packless. Joint is built with an internal sleeve of heavy wall construction for effective guiding. Inner end of sleeve has a guide ring riding on a machined bore to insure true axial movement. Limit stop prevents the joint from being extended beyond its predetermined limit.

ADSCO makes the most complete line of expansion joints of any manufacturer in the world. That means complete engineering! Come to ADSCO for the *right* joint.

Don't let pipes get out of line

Use ADSCO Alignment Guides with ADSCO Expansion Joints. Cylinder is 12" long in all sizes, permitting pipe movement of 10". Damage to insulation prevented by ample clearance between guiding cylinder and pipe.

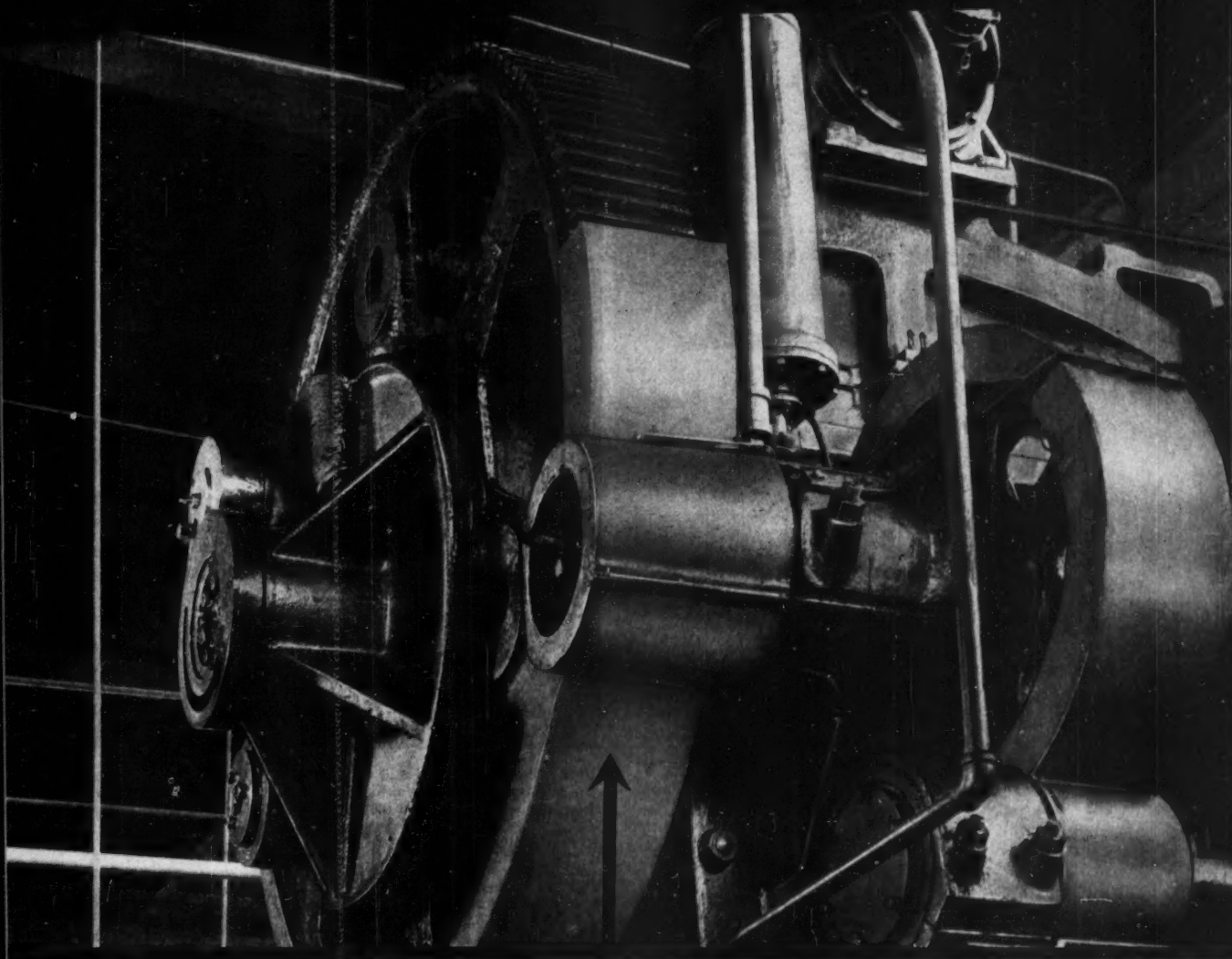


EXPANSION JOINTS • HEAT EXCHANGERS • STEAM TRAPS • STRAINERS • SEPARATORS • METERS

AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877



Excessive throw-off stopped with...

• The lubrication of exposed gears on a 250 ton press caused trouble for a midwest metal-working company. Lubricant throw-off was excessive, creating unfavorable working conditions; frequent applications of grease interfered with production and raised lubricant consumption. The gear shield in use required pre-heating.

A Standard Oil Lubrication Engineer surveyed the situation three years ago and suggested the use of Calumet Viscous Lubricant 10X, because it is a grease of superior adhesive quality and does not require pre-heating.

Since that time the plant has used Calumet Viscous Lubricant 10X with outstanding results. Run-off to the floors and other parts has been eliminated. Gears are lubricated with maximum efficiency. Most important, lubricant consumption has been cut by more than 20%.

Calumet Viscous Lubricants

Where open gears as well as some enclosed types are difficult to lubricate, try Calumet Viscous Lubricants. Their superior adhesive quality and greater wetting ability give them high resistance to the washing-action of water and to thinning and throw-off at high temperatures. Several grades of Calumet Viscous Lubricants can be applied by spraying.

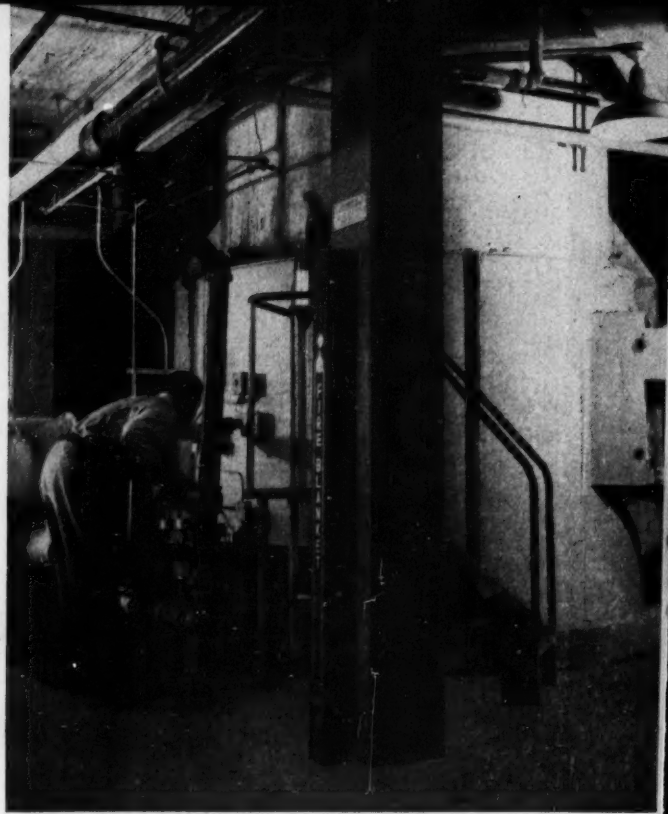
Standard Oil Lubrication Engineers are stationed throughout the Midwest. One of these specially trained men is in your area, on the spot when you need him most. To secure his services call your local Standard Oil office. Or write: Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY



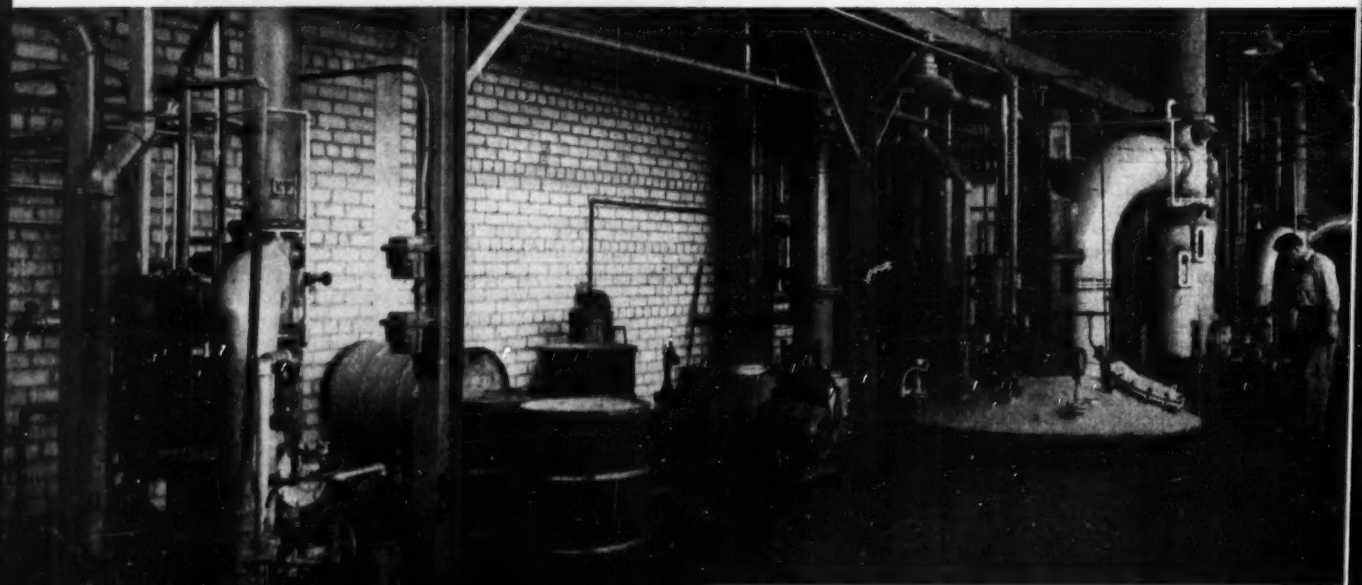
(Indiana)

Stainless Steel Kettles

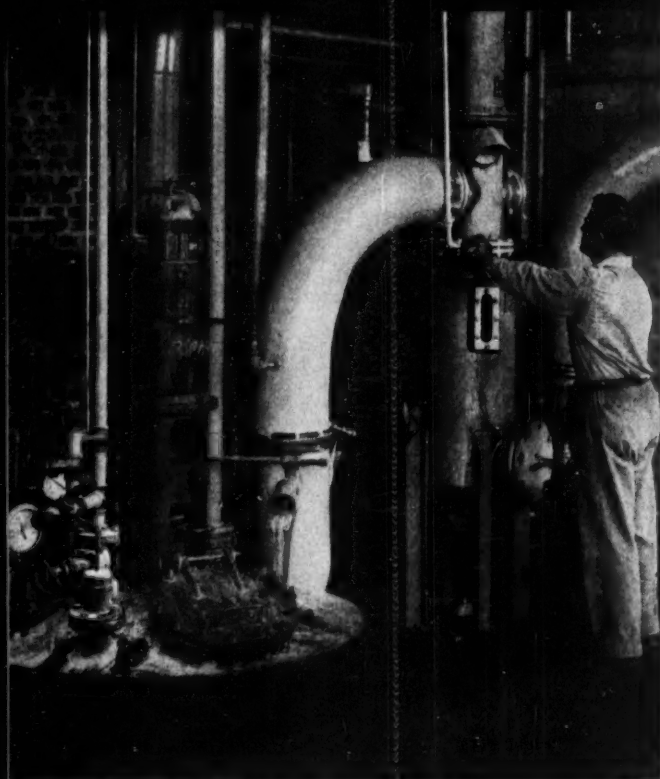


HERE is the lower part of a 2500-gallon kettle as the operator checks the burners in a furnace unit. The Stainless Steel kettle extends from the ceiling to a short distance above the operator's head.

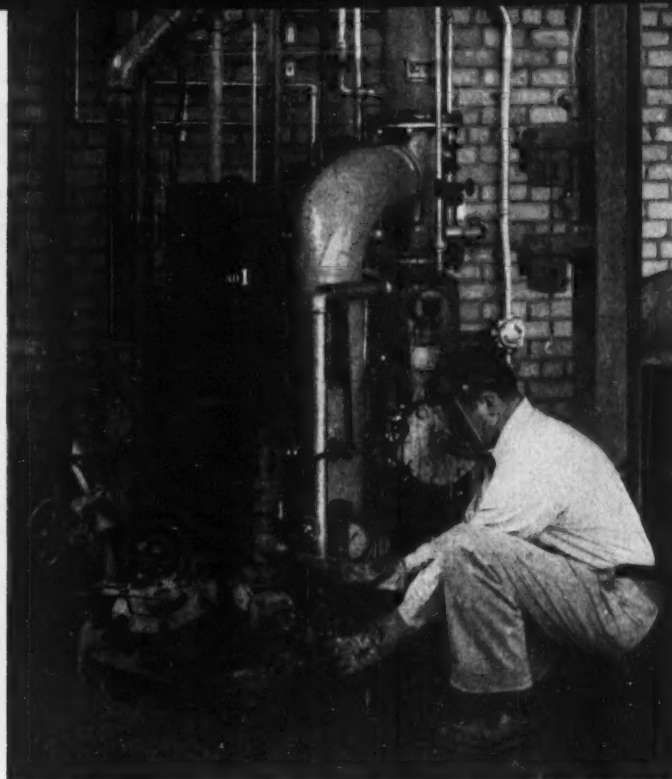
guard against contamination in solvent



THIS VIEW of the varnish room at Socony Paint Products Company shows the tops of several Stainless Steel kettles. At the left is the 150-gallon pilot kettle. In the center is one of the large 2500-gallon kettles and two medium sized kettles are in the background. A Stainless Steel cooler may be seen above the large kettle.



THE CONDENSER of a 600-gallon Stainless Steel kettle is being checked by the operator. Two Stainless Steel coolers may be seen overhead.



HERE the operator draws a sample from the 150-gallon Stainless Steel pilot kettle.

processing of varnishes and synthetic resins

• Kettles of all sizes—from 150-gallon pilot vessels up to 2,500-gallon sizes are used by Socony Paint Products Company, Metuchen, N. J. in production of a complete line of high-quality varnishes and synthetic enamel vehicles. And no matter how large or how small, the kettles are Stainless Steel.

That's because Stainless Steel is the one material best able to prevent contamination and accompanying discoloration due to the corrosive nature of the acid-type materials, especially at high temperatures. Cooking temperatures in the totally-enclosed Stainless Steel kettles range to a maximum of 590° F., depending upon the vehicle being manufactured.

Socony employs the solvent process in its operation. As the solvent evaporates, its vapor acts as a carrier for the removal of various products of reaction. Stainless

Steel condensers return the solvent to the kettle, while water and other reaction products are collected in a receiver below the condenser.

Stainless Steel's durability and its ability to stand up in the face of severe corrosion also are demonstrated in pipe and pumps used to transfer materials from storage tanks to kettles and from kettles to thinning tanks.

Socony's operation is typical of the performance of Stainless Steel on a wide variety of chemical processing jobs. As a material, it offers such a unique combination of benefits that, in many places, you cannot afford to overlook it.

And for the finest performance from Stainless Steel equipment, make sure it is fabricated from perfected, service-tested U.S.S. Stainless Steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

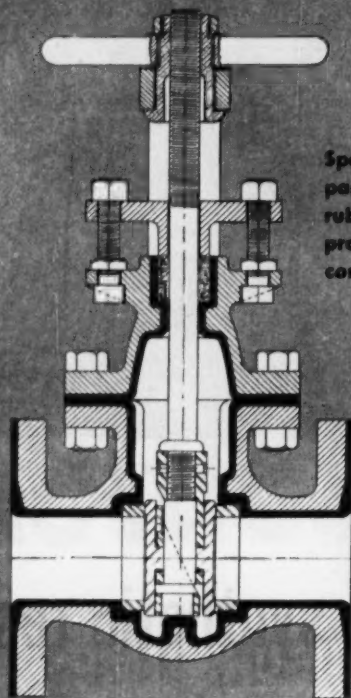
U·S·S STAINLESS STEEL



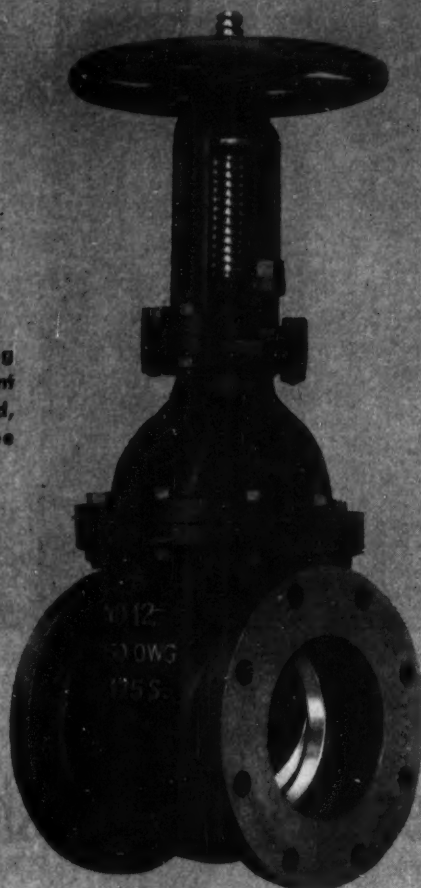
SHEETS • STRIP • PLATES • BARS • BILLETS • PIPE • TUBES • WIRE • SPECIAL SECTIONS

4-68

UNITED STATES STEEL



Special alloy working parts, and permanent rubber-to-metal bond, provide trouble-free corrosive service.



Meeting the "Acid Test" the low-cost way with **DARLING** rubber lined iron body valves!

YOU can save dollars by installing Darling rubber lined, iron body gate valves for corrosive services up to 150°F. These Darling gate valves are giving outstanding service in job after job.

You Get This Plus Value Too!

The fully revolving double disc, parallel seat principle compensates automatically for valve body dis-

tortion. Tight closure is assured every time. And wear on working parts is *uniform*.

In plant after plant Darling rubber lined, revolving disc, parallel seat gate valves are setting records of efficiency and economy. These unique rubber lined valves are made in rising stem, cylinder, motor-operated, or quick-opening types.

Ask for the special Darling rubber lined *gate* and *check* valve bulletin.

VALVES FOR EVERY NEED

Darling also offers gate valves in a wide range of sizes, types and construction for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

DARLING VALVE & MANUFACTURING CO.

Williamsport 3, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt, 19, Ontario

ALLIS-CHALMERS Reduction and Separation Equipment



Speeds Subsequent Grinding Two to Four Times

Looking for a way to speed your product reduction? If you are not *pre-mill flaking*, your procedure is not as efficient . . . not as fast as it could be.

By compacting mill feed into broad surfaced flakes, the Allis-Chalmers flaking mill makes the job of your impact mill much easier. The principle is basic . . . flakes shatter more readily than other forms of material. In actual plant operation, doubled, tripled, even quadrupled impact mill capacities have been credited to pre-mill flaking with the Allis-Chalmers flaking mill.

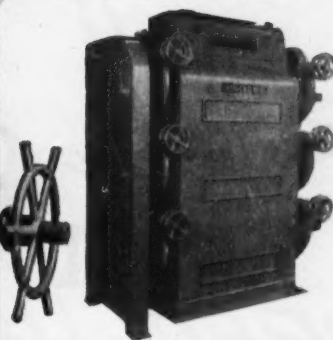
Pre-mill flaking is representative of the adaptation of Allis-Chalmers integrated equipment and engineering . . . adaptations that pay off in high production, top quality products and low processing costs. For further information, contact your nearby A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4316

Circle is an Allis-Chalmers trademark.

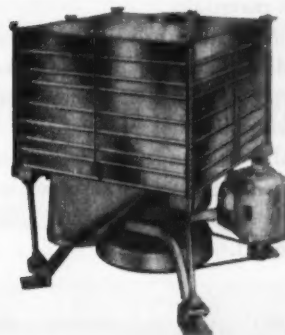
ALLIS-CHALMERS

Chemical Milling and Processing Equipment



Style N ROLLER MILLS

In the Allis-Chalmers three stage roller mill there is no excessive shattering . . . no size-destroying impact. Each progressively finer grinding is extremely gentle. Fines are kept at a minimum. Yield is greatly increased. To meet varying requirements, Style N roller mills are also available in one pair and two pair high types.



Circle SIFTER

Stacked decks save space! The Circle sifter, utilizing gyratory motion, provides the screen area of a single deck-type screen requiring *four times* the floor space. Flexible capacity, quick product changeover and positive method of tensioning screen are other advantages of the stacked deck design.



for

RICH OIL HEATING

CATALYTIC REFORMING

Specify **Struthers Wells**
VERTICAL
FIRED HEATERS

Struthers Wells Vertical Heaters are widely used throughout the petroleum industry.

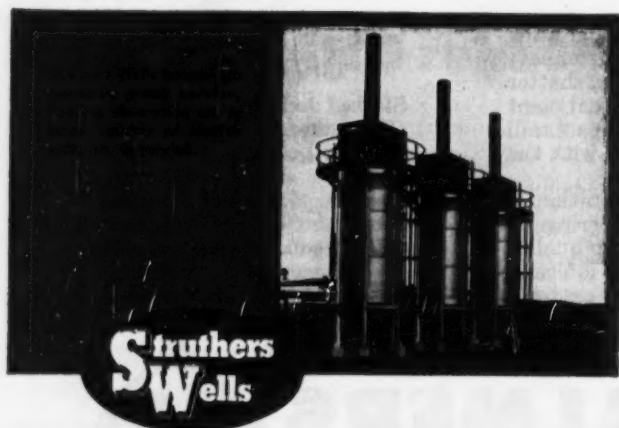
High thermal efficiencies may be secured with these Heaters—an important factor where the cost of natural gas and other fuels is increasing so rapidly.

Standard units are available in a wide range of sizes, with most equipment available for prompt shipment using stock materials.

Circulating systems are available, using oil or Dowtherm, for the indirect heating of grease kettles, reactors, and other equipment. This equipment is generally supplied complete with all accessories.

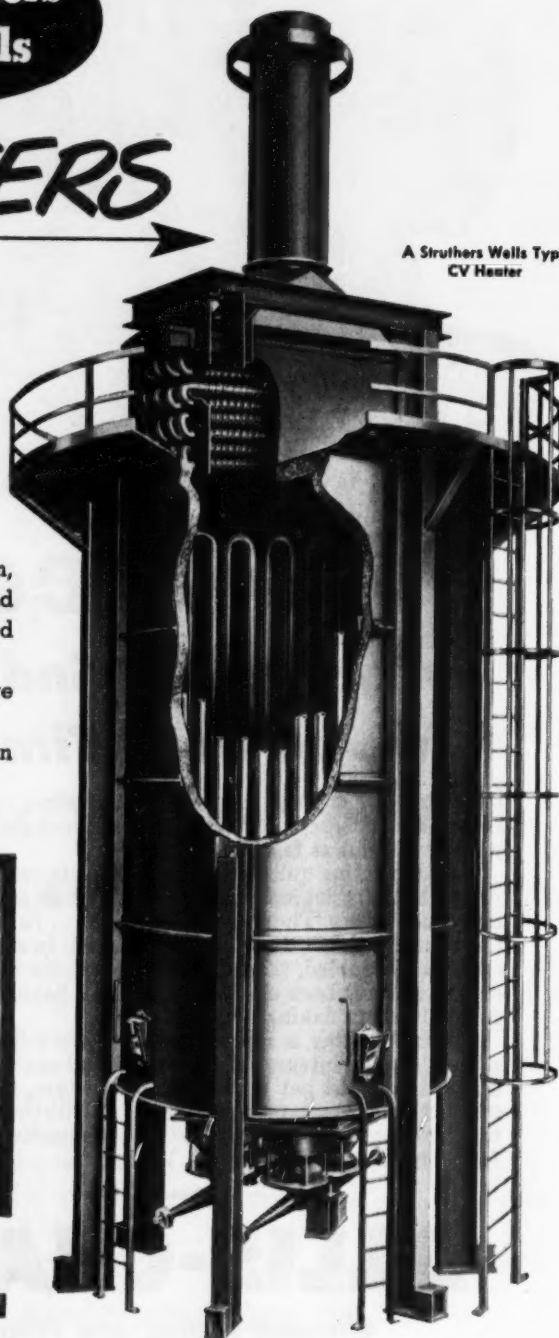
Electrically heated units for circulating heating are available for pilot plant or small scale operation.

New Bulletin C-45 is available; please send request on your letterhead.



STRUTHERS WELLS CORPORATION
WARREN, PA.

Plants at Warren and Titusville, Pa. Offices in Principal Cities



A Struthers Wells Type
CV Heater



G-E LIMITAMP controls the operation of high-voltage motor drives up to 2250 hp . . . gives you quick, silent protection for personnel and equipment against dangerous short-circuit conditions up to 250,000 kva . . . helps prevent costly shutdowns.

Safety for your personnel and equipment with high-voltage G-E Limitamp Control

Don't take chances with dangerous short-circuit conditions. G-E Limitamp Control protects against sudden electrical overloads . . . assures greater safety for your personnel and costly electrical equipment. A high-voltage motor control, G-E Limitamp Control provides interrupting capacity up to 250,000 kva.

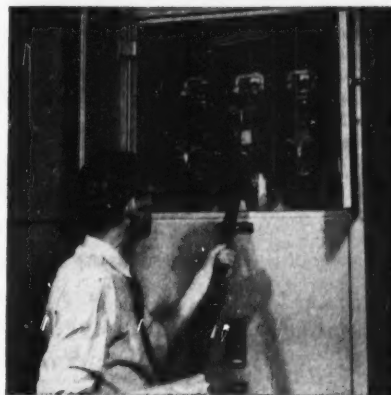
MAINTENANCE PERSONNEL is guarded by a steel barrier separating high- and low-voltage compartments. A mechanical door interlock assures motor circuit interruption before the fuse compartment door can be opened.

GET EQUIPMENT PROTECTION with General Electric Type EJ-2 fuses which clear fault current

in less than $\frac{1}{4}$ cycle, operate only under actual "short" conditions. Also, improved heavy-duty air-break contactors give you millions of operations.

FOR YOUR SPECIAL OPERATION individual components need not be specified. Let G-E application engineers select the correct components, give you the right interrupting capacity . . . better personnel and equipment safety.

FOR COMPLETE INFORMATION about G-E Limitamp Control, contact your nearest G-E Apparatus Sales Office, or write to Section 781-7 for Bulletin GEA-5409 today. General Electric Company, Schenectady 5, N. Y.



MAINTENANCE IS EASY . . . Fuses swing forward on hinges for the disconnect position and fuses can be quickly lifted out.

You can put your confidence in—

GENERAL  ELECTRIC

Safety and savings tip!



Sylphon Packless Valves prevent leakage—in or out

Illustrated—a few of many types of Sylphon Packless Valves. Sizes range from 1/4" to 6". No. 304-NV is especially suited for vacuum service.

● Once Sylphon Packless Valves are installed on pipe lines carrying gasoline, oil, or other volatile liquids and vapors, leakage stops instantly! You and your equipment are protected against possible fire, explosion or other damage. You gain more, too. For these valves prevent wastage—provide vacuum protection.

There's no packing to leak or replace. A rugged, seamless Sylphon metal bellows replaces customary packing.

The bellows eliminates leaks that might seep past the stuffing box of even the best packed type valve. It seals the valve stem against corrosive, dangerous or inflammable liquids or gases.

Many sizes and types made of brass, monel, stainless steel, etc. Widely used in chemical plants, oil refineries, power plants, aboard ships. Ideal as standard equipment. Get complete information; write for Bulletin AC-813.



Robertshaw-Fulton
CONTROLS COMPANY

FULTON SYLPHON DIVISION

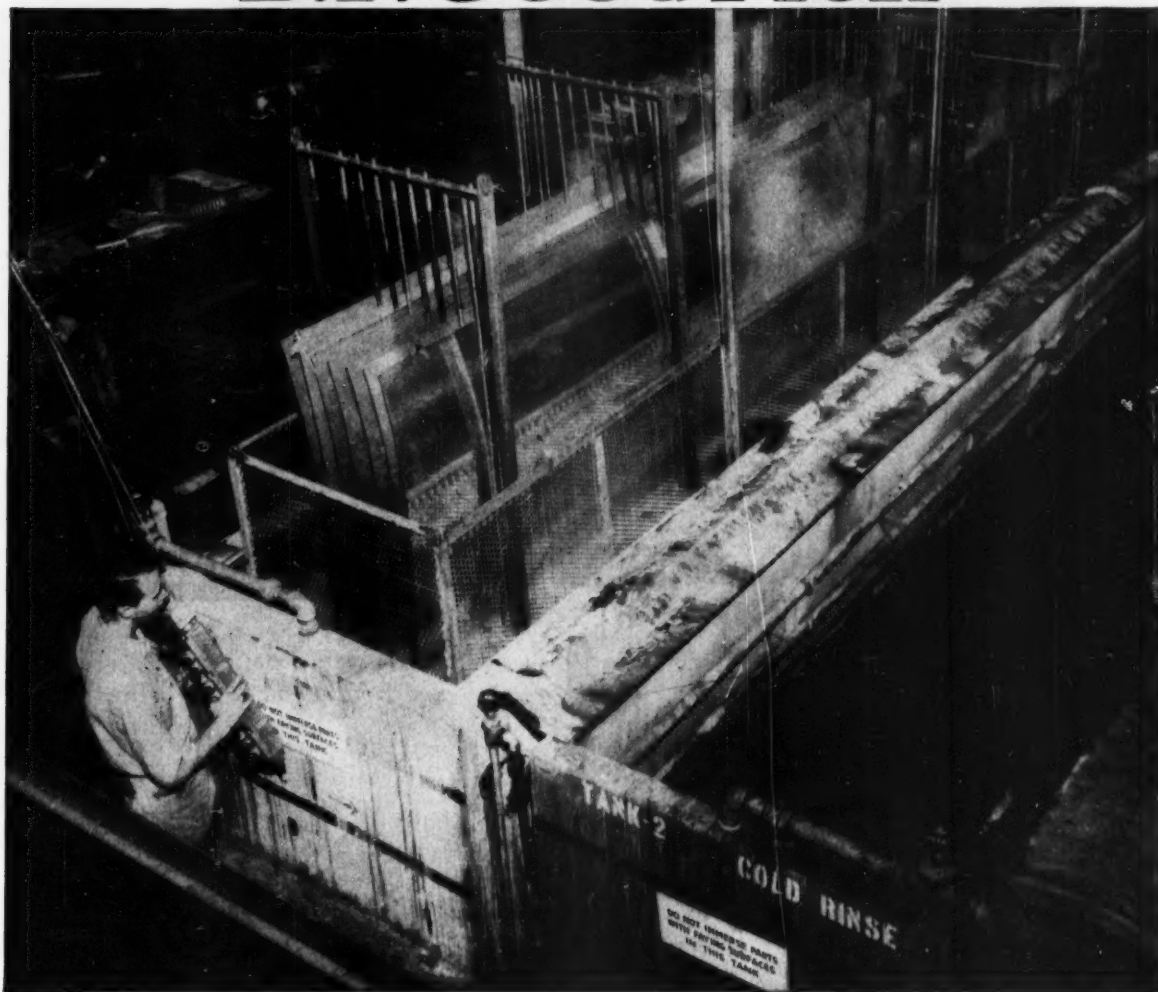
Temperature Controls • Bellows Devices • Bellows Assemblies

KNOXVILLE 1, TENNESSEE

RESEARCH KEEPS

B.F. Goodrich

FIRST IN RUBBER



Where airplane skeletons swim in acid

A typical example of B. F. Goodrich product development

BEFORE the wings and body of an airplane can be covered, the frame must be cleaned of the slightest speck. Big tanks like these were used, filled with acids that ate off scale and got the parts ready to be painted.

A faster process was developed but it had to use acids so strong that they would eat through wood and metal tanks. In fact, not even rubber tank linings could stand up against these acids.

An engineer thought of Koroseal, the material developed by B. F. Goodrich that stands practically all acids. It was

tried and worked perfectly—the two tanks in the picture are already lined with it. Koroseal made the new process possible, speeding up this vital step in airplane making as much as 50%.

Koroseal flexible material is but one example of the product development and improvement that is always going on at B. F. Goodrich. Every product that B. F. Goodrich makes—V belts, conveyor belts, hose and many other things—is constantly being studied by practical engineers to see how it can be improved from the user's standpoint,

how it can be made to last longer and do a better job.

The tanks in the picture were lined by The Barber-Webb Company for Lockheed Aircraft Corp.

To take full advantage of B. F. Goodrich practical research, call your BFG distributor, or write to The B. F. Goodrich Company, Dept. M-164, Akron 18, Ohio.

B.F. Goodrich
INDUSTRIAL PRODUCTS
DIVISION

OIC Valves

...THE MODERN LONG LINE

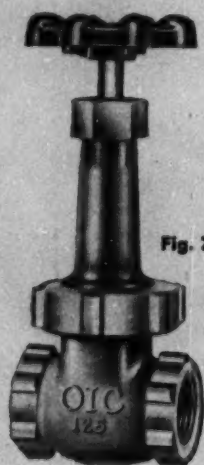


Fig. 7100

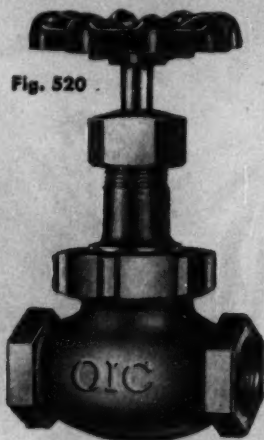


Fig. 520

BRONZE

$\frac{1}{4}$ " to 3". 125, 150, 200, 300 and 350 WSP; 300A; 200, 400, 2,000 and 2,500 WOG.

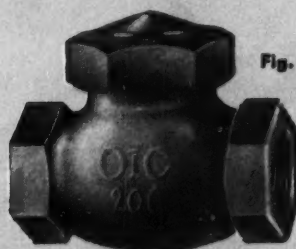


Fig. 516

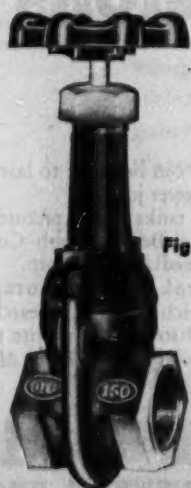


Fig. 333



Fig. 1140

IRON

$\frac{1}{4}$ " to 16". 125, 150 and 250 WSP; 175, 200, 400 and 500 WOG. $\frac{1}{4}$ " to 4" DUO-BOLT Gates.



Fig. 124



Fig. 6033

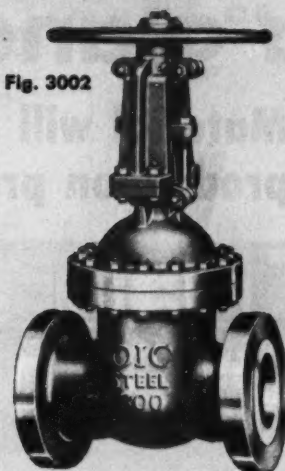


Fig. 3002

CAST STEEL

2" to 16". 150, 300 and 600 lb. primary pressure series.



Fig. 1572

FORGED STEEL



Fig. 1021



Fig. 1221

1/4" to 2" Gate, Globe, Angle, Check Valves; 600 lb. primary pressure series.

STAINLESS STEEL



Fig. 810



Fig. 815

1/2" to 2". Gate valves, 200 lb. primary pressure series.

LUBRICATED PLUG

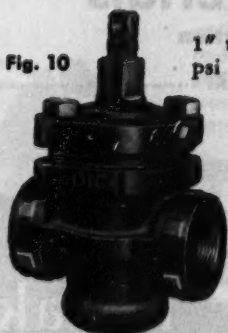


Fig. 10

1" to 24". Iron... 175 psi to 800 psi working pressures. Cast Steel series 150 lb.-250 psi, 300 lb.-600 psi and ASA 150 lb. class.

Contact your authorized OIC Distributor



Write for the OIC Catalog Digest for quick valve selection.

THE OHIO INJECTOR COMPANY

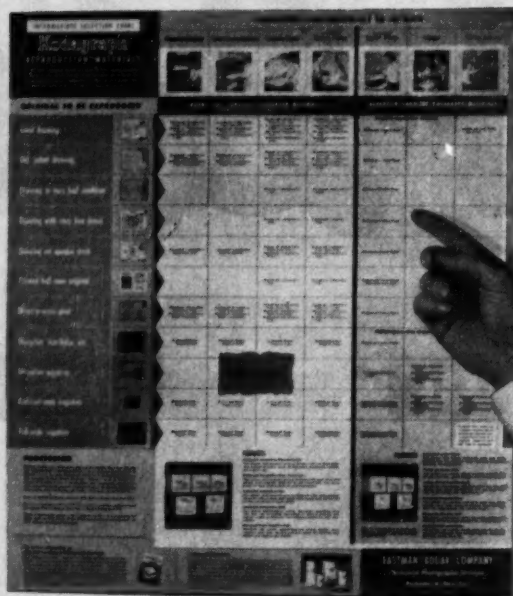
WADSWORTH, OHIO

See at a glance

which Kodagraph Material will solve today's drawing reproduction problem

Free . . .

this handy wall chart lets you select immediately the Kodagraph Reproduction Material which will give you best results in reproducing any type of drawing or other original in any type of print-making equipment.



Whether you do your own print-making or order from a local blueprinter, you will find this selection chart a helpful time-saver. And a money-saver, too, for these materials do not involve complicated techniques and are surprisingly low in cost.

The chart tells you, among other things, *which* Kodagraph Materials are specifically designed to give you sharp, clean intermediate prints of old, soiled drawings; which Kodagraph Materials are

best for reproducing blueprints, microfilm negatives, drawings with extremely fine detail, printed half-tone pages, etc.

In addition, it gives you concise descriptions of all the materials in the versatile Kodagraph line, some of which you may not be familiar with. Also, you'll find helpful tips on processing. *It's well worth sending for today.* If you'd like more than one chart, free of charge, just say how many.

Kodagraph Reproduction Materials

"THE BIG NEW PLUS" in engineering drawing reproduction

-----MAIL COUPON TODAY FOR FREE KODAGRAPH SELECTION CHART-----

EASTMAN KODAK COMPANY, Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a free copy of your Kodagraph Selection Chart.

Name _____ Position _____

Company _____

Street _____

_____ Zone _____ State _____

Kodak

105

IN STORAGE . . .

OR IN TRANSIT . . .

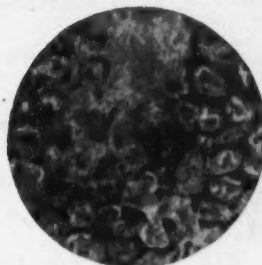


SIMPSON MIXED MATERIALS *STAY MIXED*

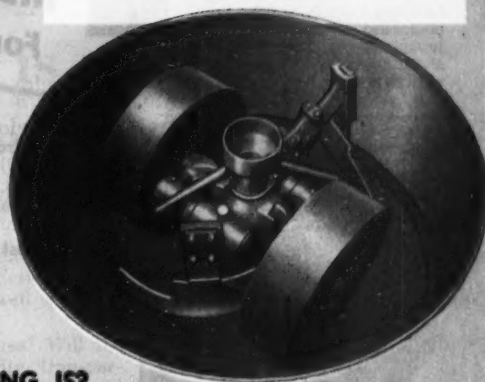
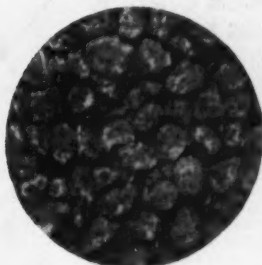
THIS you can depend on. Once materials are mixed in a SIMPSON Mix-Muller they stay mixed! Even after prolonged storage . . . or bouncing around in transit . . . where conventionally mixed materials tend to segregate or stratify . . . Simpson-mixed materials retain their constant stability.

Segregation can occur only where materials have been improperly mixed . . . where individual grains have merely been placed next to each other. Contrast this to mulling in a Simpson Mix-Muller, where each grain is subjected to a kneading, smearing, mulling action which actually blends component materials into one . . . where blending is intimate, thorough and uniform.

In addition, SIMPSON Mix-Mullers require less labor, less horsepower, and are safer to operate. You can obtain more information from a National Engineer. Write for details today.



(ABOVE) Conventionally mixed material showing typical smears of unmixed materials. (BELOW) Simpson mixed material showing complete uniformity of mix—which will remain in that form even in transit, or after long storage periods.



DO YOU REALLY KNOW WHAT MULLING IS?

Watch the practiced technique of a chemist's mortar and pestle — the intensive rubbing and smearing actions — and basically, **THAT'S MULLING!**

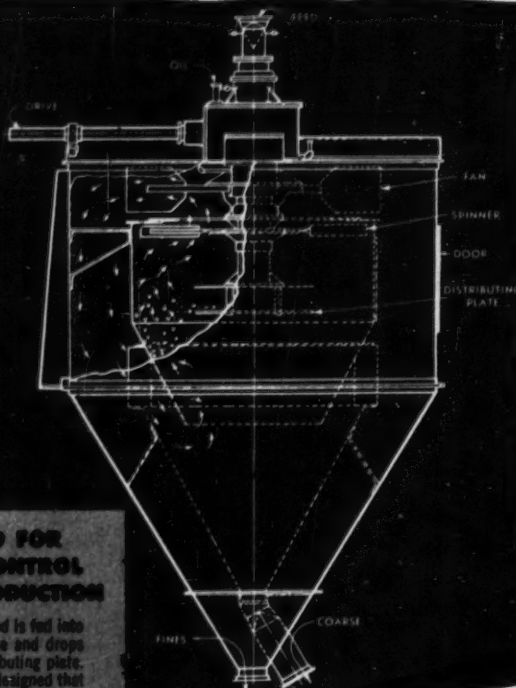
Mulling with a SIMPSON Mix-Muller utilizes a special pair of revolving mullers and plows mounted on a stationary pan. The mullers are adjustable and are supported by rocker arms. This leaves the mullers free to ride on the material creating a true mulling action as they revolve. The results are thorough, more accurate blending . . . unaffected by rough handling in transit, or in long storage periods.



SIMPSON Mix-Muller Division

NATIONAL ENGINEERING CO. 404 Machinery Hall Bldg., Chicago 6, Ill.

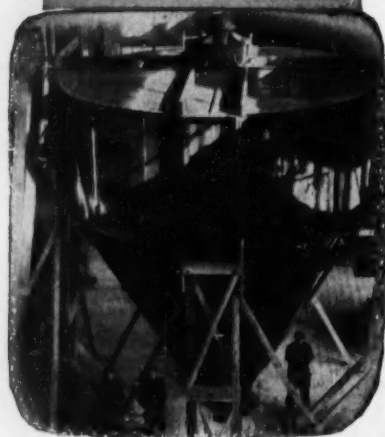




More Accurate Sizing Of Ground And Pulverized Materials!

ENGINEERED FOR PRECISION CONTROL AND HIGH PRODUCTION

Material to be classified is fed into the top of the machine and drops onto a revolving distributing plate. This distributor is so designed that it sprays the material into a rising air current which entirely surrounds the plate. The finer particles are lifted by the air stream and the coarse particles drop down to the rejects spout. Passing up through the separating chamber, the dust-laden air is given a whirling motion between Spinner blades and any remaining oversize particles are precipitated. The separator is adjustable to control the fineness of the finished product with unusual accuracy.



18-Foot Williams RC Separator being tested at plant before shipment.

WILLIAMS MECHANICAL AIR SEPARATORS For Finenesses From 30 to 325 Mesh

- Most efficient mechanical air separator ever developed for classifying ground and pulverized materials, or for removing fines from dry ground materials before classifying.
- Product quality is vastly improved and output considerably increased when operated in closed circuit with virtually any type of mill.
- Will handle with equal efficiency a complete range of products—mineral, chemical and vegetable—from the hardest, most dense limestone and ore to the softest, fluffiest starches and flours.
- Permits coarser settings in grinding equipment thus lengthening equipment life by reducing wear on all moving parts. Power consumption is much lower.
- Extra heavy construction. Equipped with anti-friction bearings encased in dust-proof and moisture-proof housings. All casings are of heavy steel plate construction. Operation is dustless and repair cost is practically nil, since there are no fine sieves to wear out and the heavy construction insures long life.

9 Standard sizes, 2½ to 18-foot diameters — Capacities from 500 lbs. to 75 tons hourly

Write For Details And Describe Your Operation
WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 NORTH NINTH • ST. LOUIS, 6, MO.

WILLIAMS

CRUSHERS

GRINDERS

SHREDDERS



OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD



Dependable Source for Chemical Raw Materials



George W. Nieder, president (left), and Carl W. Aneshansel, vice president, of Ander Chemical Company, Cincinnati, Ohio.

"Wyandotte Purecal is worth an extra processing step to us!"

— George W. Nieder, president, Ander Chemical Company

"From our previous experience with another calcium carbonate, we knew that we could use Wyandotte PURECAL to advantage in our flushed color inks," states George W. Nieder, president, Ander Chemical Company, Cincinnati, Ohio.

"Our laboratory tests and field work indicated that improved dispersion of coarse pigments resulted from the use of PURECAL as an extender. In fact, the PURECAL actually intensified the original color.

"We felt that we had to have PURECAL in slurry form to do our job right. Wyandotte Technical Service told us how to reslurry dry PURECAL in our plant and still get the results we were after. The dry powder, of course, has the advantage of lower freight charges to us, prevents freezing in winter, eliminates cost and handling of metal drums.

"True, it adds a step in our processing. However, we've built one of the finest ink businesses in the midwest, by our ingenuity in devising methods

to incorporate the highest quality products into our inks. Certainly, the benefits of PURECAL are well worth an extra step."

How about your business? Will the uniform particle size, purity, transparency, stability, suspending action, and neutral color of PURECAL* help to improve quality . . . increase sales? PURECAL, the whitest pigment extender known, is also used in paint, paper, food, drugs and rubber.

Wyandotte Chemicals Corporation,
Wyandotte, Michigan. Offices in principal cities.

*REG. U.S. PAT. OFF.



Wyandotte

CHEMICALS

MAIL COUPON FOR SAMPLES AND DATA

Wyandotte Chemicals Corporation
Department CE
Wyandotte, Michigan

Please send: ☐ free samples of Purecal
☐ more information on Purecal

For use in _____

Name _____ Title _____

Firm _____

Address _____

City _____

Zone _____

State _____

HI-LO LIMITORQUE.

2 SPEED AUTOMATIC VALVE OPERATOR

..helps to prevent SURGE
or HAMMER during
closure of valves..

The name *Limatorque* has been for years synonymous with dependable MOTORIZED VALVE OPERATION in Refineries, Pipe Lines, Power Plants, Water and Sewage Works . . . throughout the World.

Now, a device is available for use with *Limatorque* which permits a valve to be operated at 2 different speeds. This device, known as the "HI-LO" attachment permits the speed of the valve stem to be VARIED AT ANY PRE-DETERMINED POINT . . . or if required, the valve may be opened at one fixed speed and closed at another pre-determined speed.

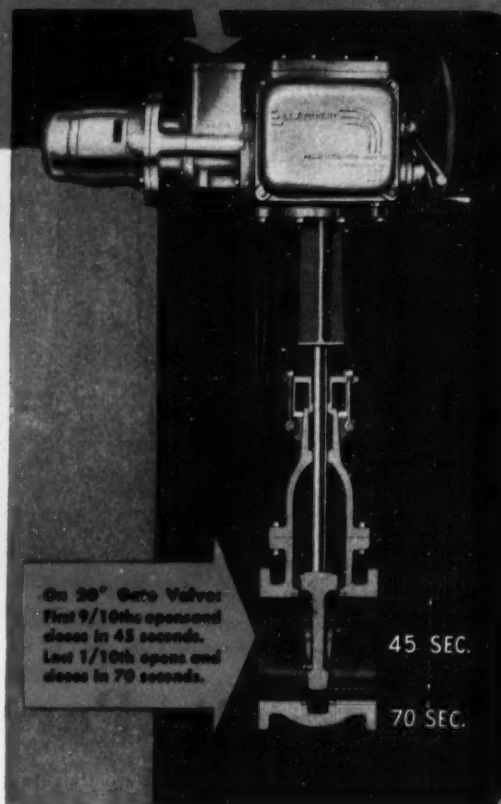
"HI-LO" is a device which prevents:

- DAMAGE to valves and station pumps.
- BREAKS in pipeline caused by "surge".
- DAMAGE to expensive equipment.
- INJURIES to personnel.

"HI-LO" is a device which minimizes or completely eliminates:

- LINE "SURGE" OR "HAMMER" during closure.
- NECESSITY OF BY-PASS VALVES because of greatly increased torque during initial valve opening.
- ELEMENT OF HUMAN ERROR, to a great extent, in operation.

The 2-Speed "HI-LO" is new, different, exclusive, and when combined with *Limatorque*, gives simple, positive, automatic and safe motorized valve operation.



Above illustration shows a 20" Gate Valve with first 9/10ths of travel closed in 45 seconds—and last 1/10th of travel to close in 70 seconds. However, change from high to low speed can be made at any pre-determined point of travel. Operation can also be fixed to obtain one speed closing, and one speed (either faster or slower) in opening of valve.

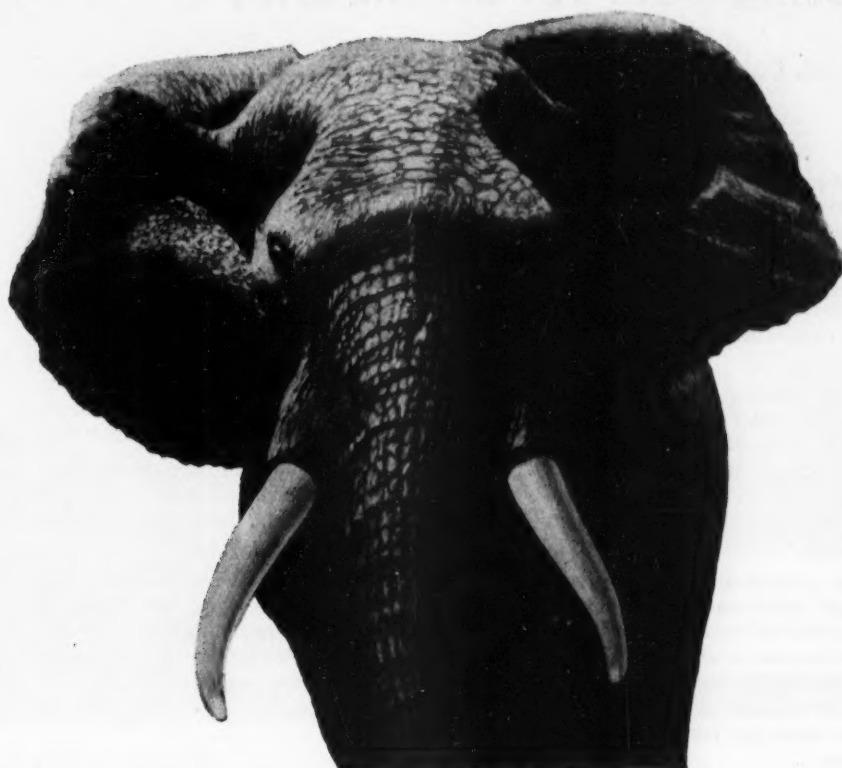
Philadelphia Gear Works, INC.



ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

You can't stop an elephant with a sling shot 



You can't stop corrosion with ordinary paints . . . it takes **BITUMASTIC COATINGS!**

CORROSION can't be stopped by ordinary paints or conventional protective coatings. They can't protect surfaces against the ravages of rust for any appreciable length of time. But Bitumastic Coatings can!

FIRST—Unlike maintenance paints, Bitumastic® Protective Coatings are specially formulated from a coal-tar pitch base* that is, for all practical purposes, impervious to water. When you keep moisture away from an exposed surface, you *stop* corrosion.

FURTHER—Bitumastic Coatings provide an extra-tough, extra-thick barrier against corrosive elements—a barrier that is impenetrable. These coatings provide up to 8 times the film thickness of conventional paint coatings.

FINALLY—Bitumastic Coatings stop

corrosion caused by moisture—acid fumes—alkaline fumes—corrosive soil—salt air—heat. There are 6 Koppers Coatings—formulated to control corrosion of metal and deterioration of concrete. Use coupon for full information.

*Hi-Heat Gray contains a metallic base.

— SEND FOR SET OF FREE BOOKLETS! —

Koppers Company, Inc., Tar Products Division
Dept. 169-T, Pittsburgh 19, Pa.

Please send me, without charge or obligation, complete information on corrosion prevention.

Name

Address

City Zone State



KOPPERS COMPANY, INC., Tar Products Division, Dept. 169-T, Pittsburgh 19, Pa.

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

Harnessing heat for all industry

HEAT is one of man's most useful servants. With it, he can separate gasoline from crude oil . . . cook food . . . generate electricity . . . refine steel from raw ore and roll it into mile-long sheets. But to do these and countless other jobs, heat must be applied in the correct amounts . . . to obtain critical temperature values.

Forward-looking research and production men realized some years ago that "rule of thumb" was entirely inadequate for replacing complex processes. They needed facts obtainable only from automatic measurement . . . performance possible only through automatic control.

Honeywell has consistently led the way toward new and better temperature instrumentation. Continuing research has developed sensing elements which cover the full temperature spectrum . . . instruments which provide the desired accuracy . . . and automatic controls which can regulate any production process.

instruments

The complete Honeywell family offers a broad choice of characteristics to suit individual applications. *ElectroniK* indicators, circular chart and strip chart recorders and controllers afford the peak in performance through "Continuous Balance" high-speed

electronic measurement. *Pyr-O-Vane* millivoltmeter instruments fit many processes which need accurate indication and control. Brown Thermometers are economical instruments for recording and controlling moderate temperatures.

controls

With *Pyr-O-Vane* instruments you can have electric control of either the two-position, three-position or time-proportioning types.

With Thermometers, you may choose from electric two-position, pneumatic on-off or proportioning control, and cam-operated program control.

With *ElectroniK* instruments, your selection covers practically any form of electric or pneumatic control, including the most advanced types suitable for complex processes, and the most flexible program controls.

Processing of *protected*

sensing elements

thermocouples



the most versatile of temperature elements, are supplied for ranges from -300 to $+2800^{\circ}\text{F}$.

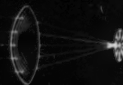
resistance thermometers



are recommended for highest accuracy from sub zero to 300°F and for narrow spans.

Radiomatic

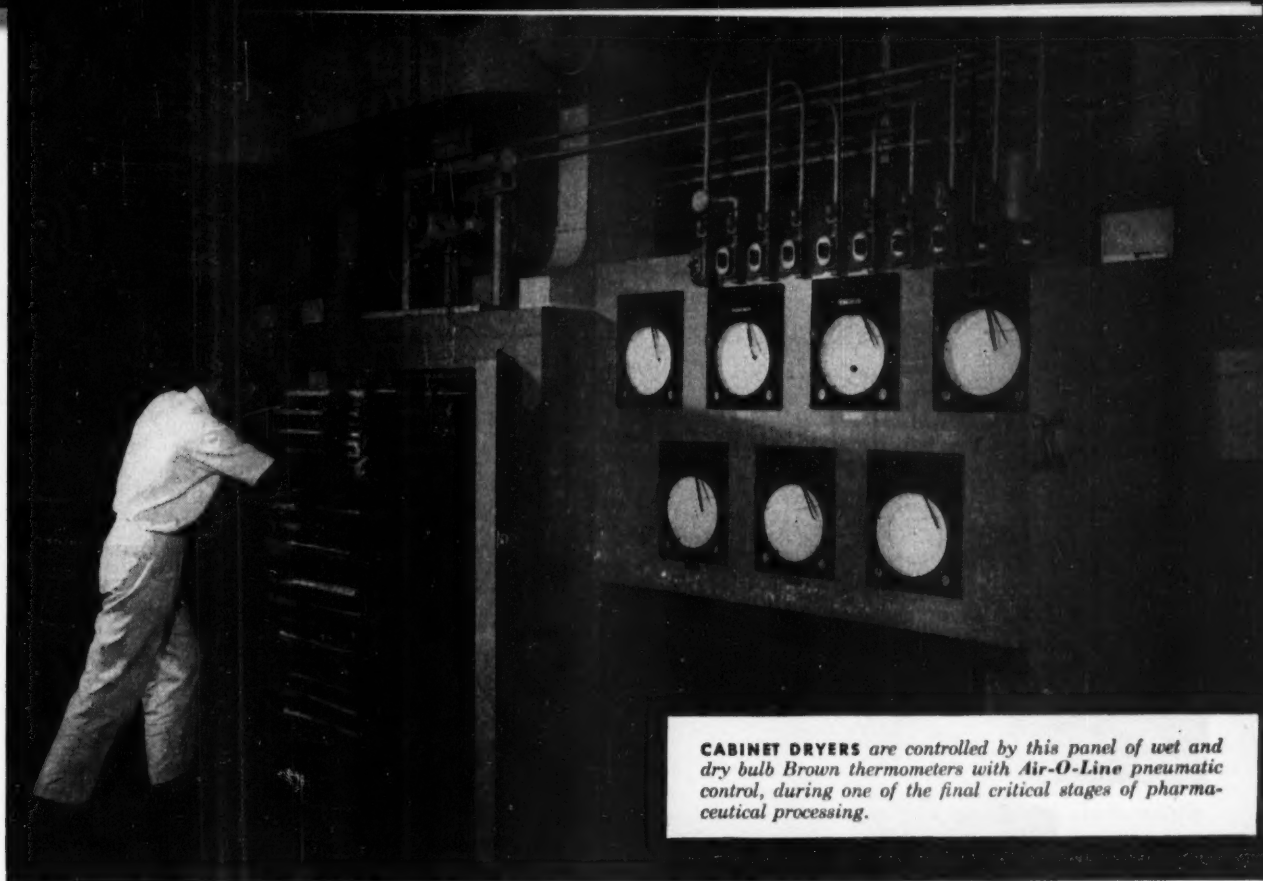
(radiation type) elements are applicable to direct measurement of work temperature to moving objects to extremely high ranges and other jobs impossible for any other element.



thermometer bulbs



rugged, sensitive elements for moderate temperatures.



CABINET DRYERS are controlled by this panel of wet and dry bulb Brown thermometers with Air-O-Line pneumatic control, during one of the final critical stages of pharmaceutical processing.

sensitive pharmaceuticals *by Honeywell Instrumentation*

A few degrees in temperature . . . or a few millimeters of mercury of vacuum . . . can spell the difference between successful production and spoilage, in the processing of pharmaceuticals at G. D. Searle & Co., Chicago. To keep batch reactors and driers operating within close limits, this company utilizes a large number of Honeywell controls.

Many of the materials which go into pharmaceutical production are highly sensitive to temperature changes. The glass-lined reactors in which these materials are processed are thoroughly instrumented . . . with Brown thermometers to record vital temperatures for operators' guidance. Because pressure affects reactions too, many reactors are equipped with Brown absolute pressure indicators. These instruments, automatically compensating for atmospheric pressure changes, readily indicate vacuums within a few millimeters of mercury . . . and the operator does not have to correct readings for ambient conditions.

In drying processes, accurate regulation of wet and dry bulb temperatures, by means of thermometer controllers, prevents moisture absorption by hygroscopic products, and avoids chemical decomposition of sensitive drug materials. Other controls keep safe negative pressures in the drying cabinets, and protect steam heating coils from sudden overloads in cold weather. As an aid to cost accounting, evenly-graduated flow meters continuously check steam consumption of manufacturing departments.

Whether your own process is batch or continuous, you can help it reach highest efficiency with industry-proved Honeywell controls. Our local field engineer will be glad to discuss your requirements . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO.,
Industrial Division, 4478 Wayne Ave., Philadelphia 44,
Pennsylvania.

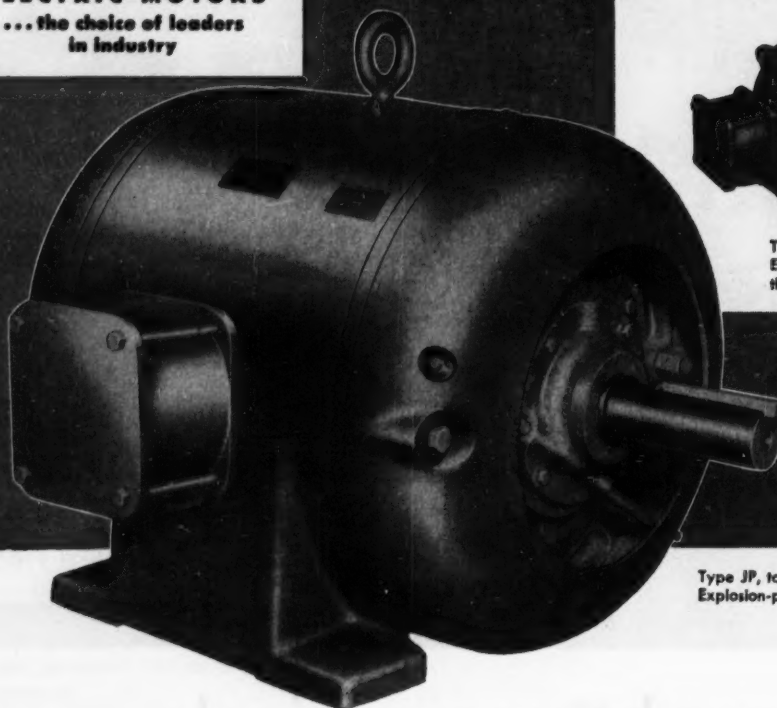
● **REFERENCE DATA:** Write for Composite Catalog No. 5000, for a brief description of the complete Honeywell line.



MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

First in Controls

Wagner®
ELECTRIC MOTORS
...the choice of leaders
in industry



Type JP, non-ventilated.
Explosion-proof. ½
through 1½ hp.

Type JP, totally-enclosed fan-cooled.
Explosion-proof. 2 to 250 hp.

for extra protection against corrosion

*SPECIFY **Wagner** CAST IRON FRAME MOTORS*

Here are stock motors specifically designed for use in chemical plants, oil fields, refineries, steel mills—for rugged industrial applications where dust, dirt, moisture, or corrosive vapors are present.

These motors are totally-enclosed in corrosion-resistant cast iron and all parts exposed to the atmosphere are of corrosion-resistant material—including the nameplate. They feature completely protected laminations... special varnish treated windings... and a running shaft seal.

Wagner Cast Iron Frame Motors are available in fan-cooled standard and explosion-proof types in ratings from 2 to 250 hp, and in non-ventilated standard and explosion-proof types in ratings from ½ through 1½ hp. Wagner Bulletin MU-132 gives complete information.

A skilled Wagner engineer can help you select a Wagner Motor to meet your most exacting specifications. Call the nearest of our 32 branch offices, or write us.



WAGNER ELECTRIC CORPORATION
6407 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE
BRAKE SYSTEMS—
AIR AND HYDRAULIC

THE LABORATORY USES PORCELAIN



SO CAN YOU!



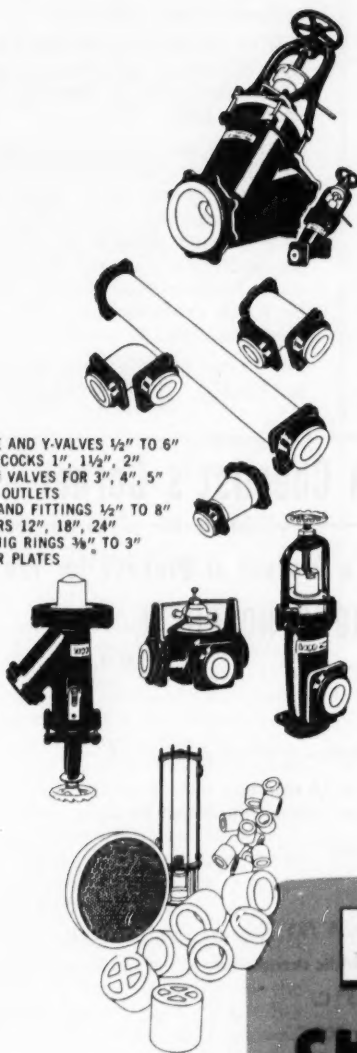
In putting new processes into production, there's no need to compromise with purity because industrial-scale equipment won't duplicate laboratory results . . . Nor to search for substitute materials that will produce equivalent results. Why not use the same materials in which the laboratory worked out the process?

Chemical Porcelain, world-wide standard for laboratory purity, is available from Lapp in equipment for pilot-plant and industrial production. In a wide variety of valve styles, in pipe and fittings, in towers and raschig rings, and many special shapes. It costs much less initially than special alloy or lined equipment, and, even in cases of most severe acid corrosion, usually requires no maintenance.

If you're unusually concerned about protection of product, plant, or personnel against accident or carelessness, specify Lapp Chemical Porcelain with TUFCLAD armor (multiple layers of heavy fiberglass fabric bonded with an Epoxide resin). TUFCLAD serves as protection against impact, insulation against thermal shock—and is of itself strong enough to hold operating pressures even if porcelain is cracked or broken.

For severe corrosion service, or where no metallic contamination can be tolerated, join the hundreds who have found Lapp Chemical Porcelain the only satisfactory—and most economical—processing material.

ANGLE AND Y-VALVES 1/2" TO 6"
PLUG COCKS 1", 1 1/2", 2"
FLUSH VALVES FOR 3", 4", 5"
TANK OUTLETS
PIPE AND FITTINGS 1/2" TO 8"
TOWERS 12", 18", 24"
RASCHIG RINGS 3/8" TO 3"
TOWER PLATES



Lapp
CHEMICAL
PORCELAIN

WRITE for description and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 157 Wendell St., Le Roy, N. Y.



for your information...

brief summaries of helpful product news



Two New Plasticizers Added to Monsanto Line

Two low-temperature plasticizers for polyvinyl chloride resins are now available in commercial quantity from Monsanto.

The products, additions to the company's wide range of plasticizers, are Di (2-ethylhexyl) adipate (DOA) and Di-n-octyl, n-decyl phthalate (DNODP).

DOA imparts excellent low-temperature flexibility as well as heat and light stability, and is extremely useful for controlling the viscosity of plastisols. It is recommended for use with polyvinyl chloride garden hose, film and fabric coatings. It is also effective in vinyl plastisols for toys, footwear, sponge and other products.

DNODP is recognized as the most economical quality plasticizer for obtaining good low-temperature flexibility, low volatility, good heat and light stability and water resistance. It also imparts excellent viscosity characteristics to plastisols. DNODP is especially useful in vinyl film and sheeting for upholstery and draperies, fabric coatings and garden hose. It results in up-graded products with good flexibility and permanence and resistance to soapy and boiling water.

These two products can be supplied in drums or tank cars and, where feasible, in tank truck quantities. For more information, send coupon.

Ortho-Nitrochlorobenzene Has Wide Number of Uses

ONCB—ortho-nitrochlorobenzene—is sometimes called “an intermediate's intermediate” because of its versatility and high reactivity in the production of many derivatives which serve as intermediates.

It can be used in reduction, ammonolysis, hydrolysis, nitration and ether synthesis. These varied reactions make it extremely useful in the production of intermediates for a wide variety of industries.

Dyes, sulfa drugs, medicinals, mildew-proofing agents and photographic developers are all made from intermediates pro-

duced with the help of ONCB.

Perhaps this versatile compound can help *your* product or process. Mail the coupon for more information.

Benzoic Acid (Technical) Widely Used by Industry

Benzoic acid (technical) is supplied by Monsanto as a white powder which assays 99.0% minimum. This versatile compound has numerous applications.

Benzoic acid is used in the manufacture of benzoates and benzoyl compounds. It acts as an intermediate in the production of dyes; as a mordant in calico printing; as a dispersing agent in the grinding of pigments.

One of the most recent applications of benzoic acid is as a carrier in the dyeing of “Dacron,”[†] polyester fiber.

Monsanto would welcome specific inquiries on benzoic acid and its present uses, possible future applications and reactions. This product offers a wide field for experimentation and development. Experimental samples will be made available to qualified chemists.

For a copy of bulletin on dyeing of “Dacron,” send the coupon.



Research Chemist's Corner

Can This Compound Improve a Product or Process for You?

TRIETHYL THIONOPHOSPHATE

Formula: $(C_2H_5O)_3PS$

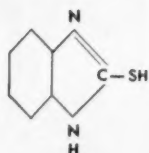
Mol. Wt.
198.22

Approximate Properties

Appearance:	Clear, colorless to straw-colored liquid
Boiling Point:	100° C. at 16 mm. Hg. 216° C. at 745 mm. Hg. (decom.)
Crystallization Point:	approx. 2.1° C.
n_D^{25}	1.447
Specific Gravity:	1.064 at 25°/25° C.
Odor:	Characteristic strong odor
Wt. per U. S. Gallon:	8.9 at 25° C.
Surface Tension, dynes/cm.:	29.65 at 20° C.
Solubility:	Soluble in benzene, heptane, carbon disulfide, carbon tetrachloride, ethanol, methanol, acetone, ethyl ether, ethyl acetate. Insoluble in water.

Pilot plant quantities available.

2-Mercaptobenzimidazole Available



Research quantities of 2-mercaptobenzimidazole are now available from Monsanto. This compound with a molecular weight of 150.19 is soluble in alcohol, ethyl acetate and acetone. It is insoluble in other common organic solvents and has a melting point of 295-300°C. It has the appearance of pearly flakes.

For a technical data sheet on this product, send in the coupon.

Samples available to qualified research organizations.

Methyl Salicylate Masks Odors

An effective use of versatile methyl salicylate is its application as an odorant and masking agent in glues used on gummed tape.

The addition of small quantities of this product masks unwanted odors and replaces them with a pleasant, appealing scent.

For information on this application mail in the coupon.

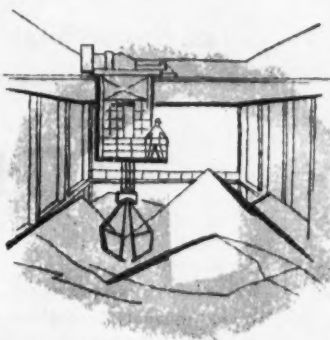
New Bulletin on Masonry Paint Formulating

A completely revised bulletin, recently published by Monsanto, will act as guide in formulating a variety of finishes using Pliolite** and Monsanto Aroclors.* These finishes include exterior types for poured concrete, cinder blocks, asbestos cement shingles, stucco, brick and similar masonry surfaces. High styrene-butadiene copolymer resins formulated with Aroclors make excellent paint vehicles and are also easy to formulate.

The bulletin describes general physical and chemical characteristics of the Aroclors and the general properties of Pliolite S-5 Resins. This material is followed by several sections which cover grinding, mixing, formulating and other valuable manufacturing information for those in the surface coating field.

For your copy of this Bulletin No. P-126, entitled "Aroclors in Formulating High Styrene-butadiene Copolymer Surface Coatings (Pliolite S-5 Resins)," send in the coupon.

Similar information is available on Marbon† 9200 resin, high styrene-butadiene formulations. Send for bulletin P-149.



Wetting Agent Aids Making of Superphosphate

Manufacturers of superphosphate have a new and extremely valuable processing aid—Sterox* AJ.

This wetting agent added to the acid during manufacture reduces surface tension and makes certain the acid will mix and react with the phosphate rock much more quickly than would otherwise be possible. This helps to assure a more complete reaction between the ingredients.

These advantages mean that users of Sterox AJ for superphosphate manufacture get a product which cures quickly and is free of hard, troublesome lumps.

Sterox AJ is particularly suited for this application because of

its solubility in acid and excellent stability.

For more complete information on this new development, send in the coupon.



Dianisidine Diisocyanate Now Available

Continuing its program of steady growth and expansion to meet the increasing demands of industry for isocyanates, Monsanto has now made available in commercial quantities another new product, dianisidine diisocyanate.

This new compound will undergo all of the diisocyanate reactions. It has been developed because a high melting product is often needed in foams, elastomers, and other diisocyanate-polyester products.

Dianisidine diisocyanate joins Monsanto's large and growing family of isocyanates now being used in such applications as adhesives, polyester rubber, foamed-in-place resins, flexible foams and surface coatings.

For technical data sheet on this product mail in the coupon, now.

*Reg. U. S. Pat. Off.

**Trade Name Reg. U. S. Pat. Off. Goodyear Tire & Rubber Co.

†Trade Name Reg. U. S. Pat. Off. Marbon Corp.

‡Trade Name Reg. U. S. Pat. Off. E. I. Du Pont de Nemours & Co., Inc.



MONSANTO CHEMICAL COMPANY

1702 South Second Street, St. Louis 4, Missouri

Please send information on:

- ☐ DOA
☐ DNODP

Please send:

- ☐ Literature on Sterox AJ as used in superphosphates
☐ Data sheet on dianisidine diisocyanate
☐ ONCB Bulletin
☐ Marbon Bulletin P-149

☐ Methyl Salicylate for Adhesives

- ☐ "Dacron" Dyeing Bulletin
☐ Data sheet 2-Mercaptobenzimidazole
☐ Data sheet Triethyl Thionophosphate
☐ Aroclors Bulletin P-126

Please send samples:

- ☐ 2-Mercaptobenzimidazole
☐ Triethyl Thionophosphate

Name..... Title.....

Company.....

Street.....

City..... Zone..... State.....

PROOF... *in your own hands!*

... proof of the efficiency
and dependability of

WELSBACH ZONE

For the research man who has an oxidation problem... whether in finding a replacement for costly conventional oxidants or in developing new and better products... there's an easy way to prove Welsbach Ozone's superiority. Test it yourself... in your own laboratory—in your own process. Welsbach's Model T-23 Laboratory Ozonator can give proof positive—in your own hands—that Welsbach Ozone is the oxidant of choice... for you.

WELSBACH OZONE

1. Quantitative reaction
2. Fully automatic
3. Always available
4. Constant operating cost
5. No materials handling or storage expense
6. Purer products—only oxygen added
7. Instantaneous reaction
8. Reacts at ordinary temperature and pressure

ORDINARY OXIDANTS

1. Inefficient oxidation
2. Increasing labor and supervisory cost
3. Difficult to procure
4. Uncertain chemical price
5. Increasing materials handling and storage expense
6. Post-oxidative clean-up needed
7. Long reaction time
8. High temperatures and pressures required

GET THE PROOF...
IN YOUR OWN HANDS

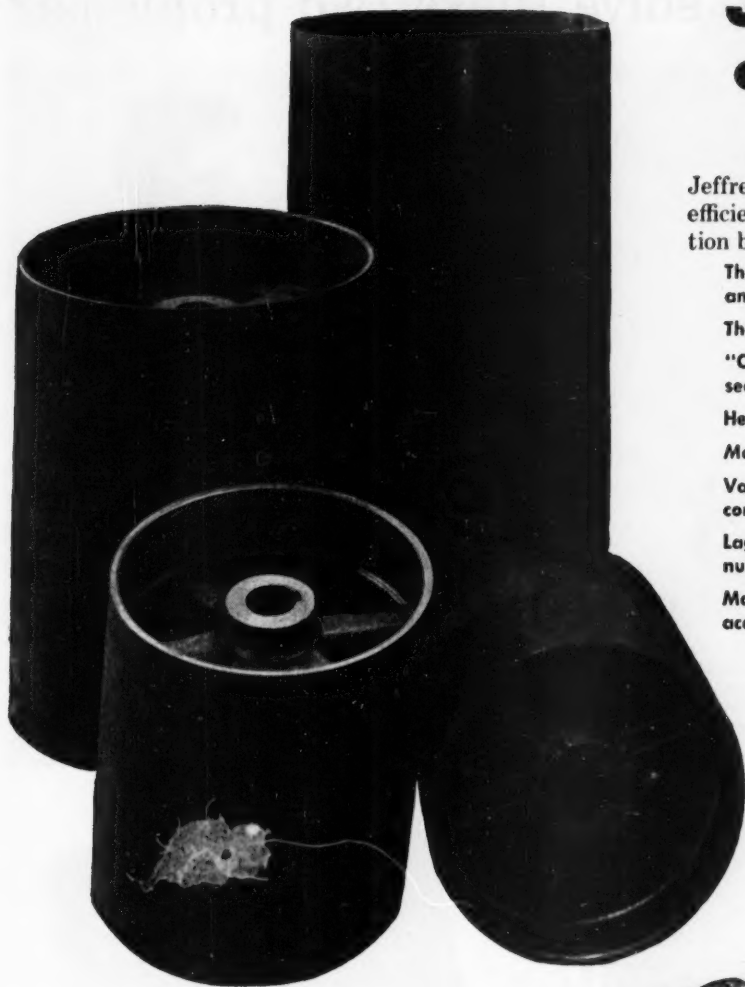
check the value of

WELSBACH ZONE

THE WELSBACH CORPORATION

ZONE PROCESSES DIVISION
1500 Walnut Street Philadelphia 2, Pa.

Pioneers in Continuing Ozone Research



JEFFREY cast pulleys are better

Jeffrey Cast Iron Pulleys insure the most efficient and economical belt conveyor operation because:

They are more resistant to corrosion, abrasion and rust.

They do not require absolutely stiff shafts.

"Clamp" type hubs really grip shaft, avoid key seat wear.

Heavy machine-turned rims are more accurate.

Machine-turned faces are truly concentric.

Variable hub positions on shaft meet all special conditions.

Lagging can be vulcanized or secured with lock nuts which won't back out.

Machined crown faces aid belt training, are accurate and uniform.

Jeffrey Pulleys are cast in one piece from highest quality grey iron. There is a type and size to meet every belt conveyor requirement... including single or double arm, solid or clamp hubs, and extra-heavy units for high-tension belts.

Jeffrey Cast Pulleys have given trouble-free and continuous service on outstanding conveyor jobs for more than 30 years. They hardly ever wear out!

JEFFREY BELT CONVEYOR EQUIPMENT INCLUDES:

Belt Idlers — all types	Drive Chains
Pulleys	Pillow Blocks
Gears	Sprockets
Shafting	Couplings
Set Collars	Holdbacks
Takeups	Belt Cleaners

WRITE FOR CATALOG NO. 852



THE JEFFREY MANUFACTURING CO.

Columbus 16, Ohio

*sales offices and distributors
in principal cities*

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

**IF IT'S MINED, PROCESSED OR MOVED
...IT'S A JOB FOR JEFFREY!**

How would YOU solve these two problems?



1. HE LIKES LIFE SAVERS because they're good. Life Savers Corporation had the problem of *exactly* determining candy moisture content — required 1°F temperature control — found this *accuracy* in Fenwal All-Purpose THERMOSWITCH® unit. Cost of control was low — results excellent.



2. PARAFFIN BATHS are important physical therapy equipment. For safety, temperature must be held within close limits. Makers of Dickson Paraffin Baths selected Fenwal THERMOSWITCH devices as entirely dependable and accurate in controlling heating unit.



3. A FENWAL THERMOSWITCH CONTROL may solve your problems, too. Its external, single-metal shell expands or contracts *instantly* with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of otherwise costly problems.



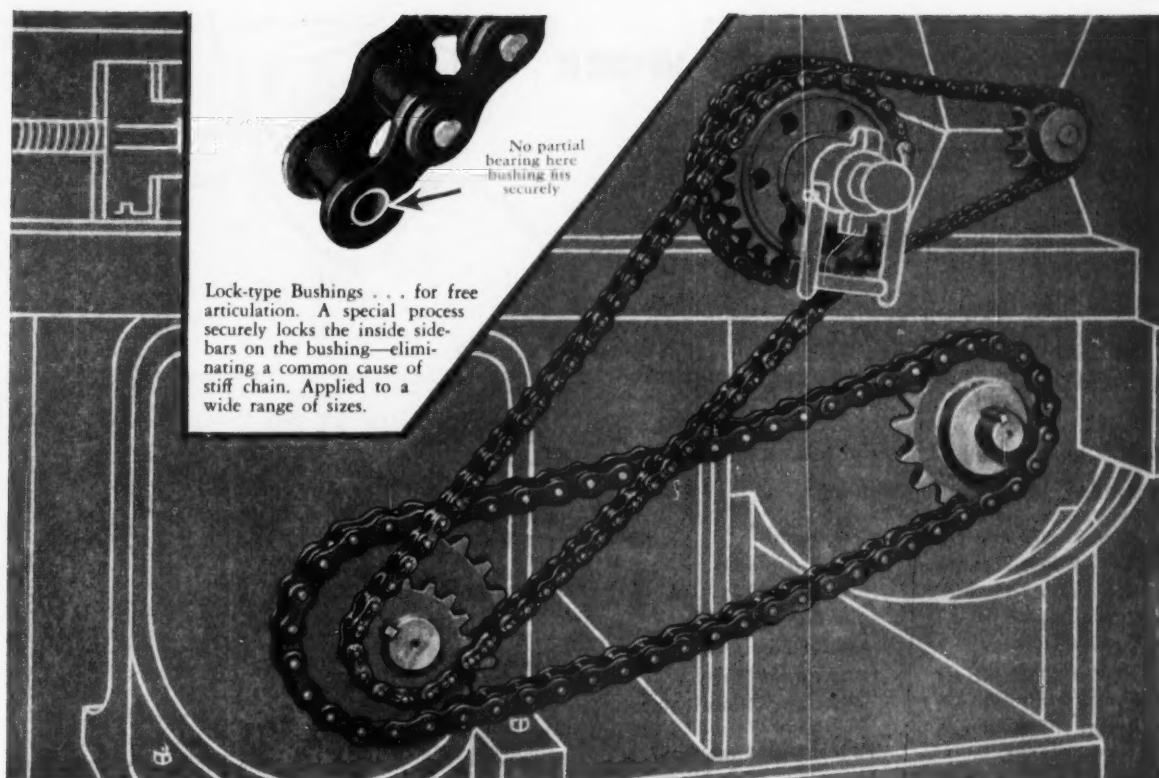
4. SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal Inc., 162 Pleasant Street, Ashland, Massachusetts.



THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE... but only to heat



Look to LOCK-TYPE BUSHINGS for longer roller chain life

Just one of many engineering extras
you get from LINK-BELT

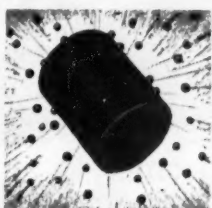
FOR drives that must operate under severe conditions, it will pay you to use Link-Belt Precision Steel Roller Chain. Lock-type bushings and the many other Link-Belt engineering extras add up to *built-in* extra life. Whether it's for power transmission or conveying, you are assured of a positive, flexible, economical chain . . . with high sustained efficiency. For complete information, see your nearby Link-Belt sales representative or distributor, or write for Engineering Data Book 2457.

LINK-BELT
ROLLER CHAINS & SPROCKETS

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle; Scarboro, Toronto and Elmira, Ont. (Canada); Springs (South Africa); Sydney (Australia). Sales Offices, Factory Branch Stores and Distributors in Principal Cities.

19,390-A

Don't overlook
these other
LINK-BELT extras



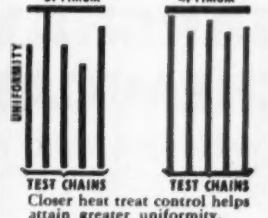
Shot-peened rollers have extra fatigue life under impact.

PIN CONTACTS OUTER SURFACE
FOR LOAD DISTRIBUTION



PIN CONTACTS OUTER SURFACE FOR LOAD DISTRIBUTION
Couple and uncouple multiple-width chains more easily.

ORDINARY CONTROL L-B EXACT CONTROL



HARSHAW FLUORIDES WORK

like magic

BORON TRIFLUORIDE

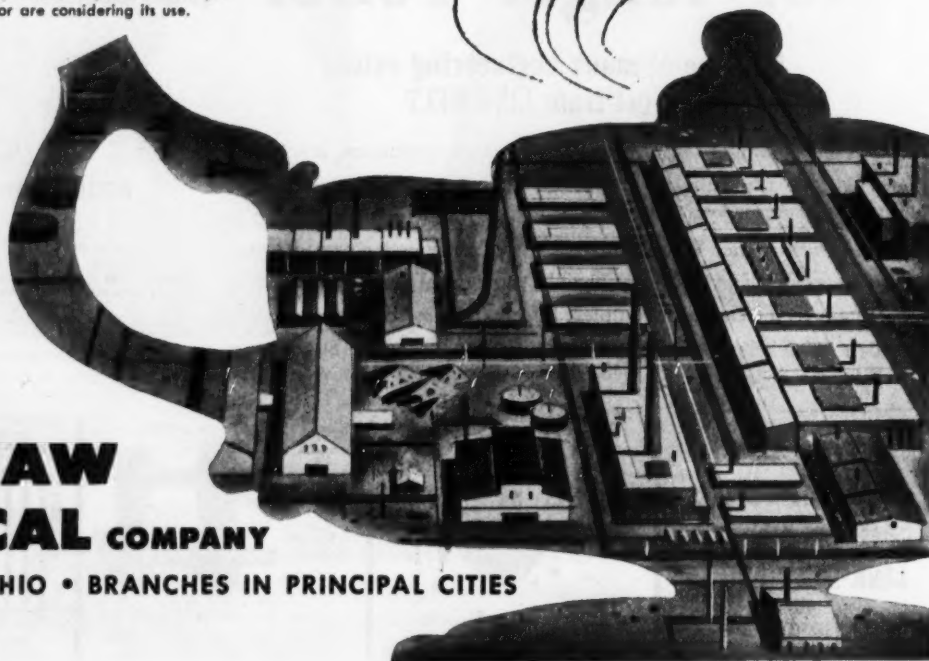
HYDROFLUORIC ACID

• ANHYDROUS • AQUEOUS

Here is an additional group of production-controlled, high-quality fluorides:

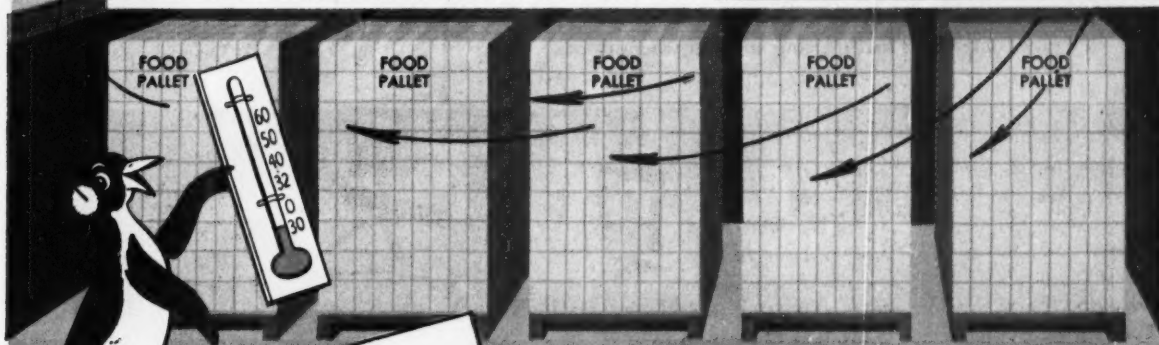
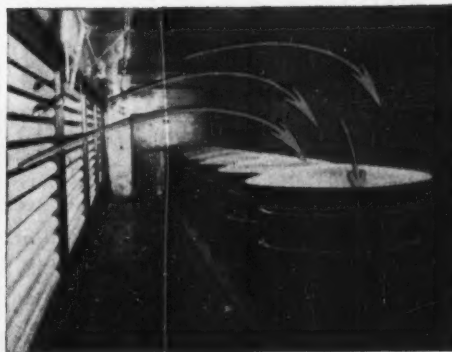
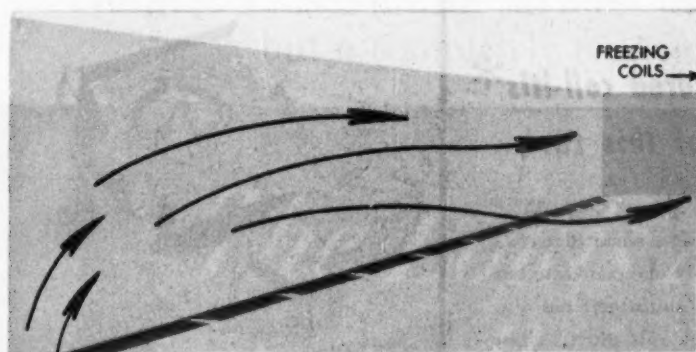
Ammonium Bifluoride	Hydrofluoric
Ammonium Fluoborate	Acid Aqueous
Antimony Trifluoride	Hydrofluosilicic Acid
Sublimed	Lead Fluoborate
Barium Fluoride	Metallic Fluoborates
Bismuth Fluoride	Potassium Bifluoride
Boron Trifluoride	Potassium Chromium
Boron Trifluoride	Fluoride
Complexes	Potassium Fluoborate
Chromium Fluoride	Potassium Fluoride
Copper Fluoborate	Potassium Titanium
Fluorboric Acid	Fluoride
Fluorine Cells	Silico Fluorides
Fluorinating Agents	Sodium Fluoborate
Frosting Mixtures	Tin Fluoborate
Hydrofluoric Acid	Zinc Fluoborate
Anhydrous	Zinc Fluoride

Write for Harshaw's 40-page Book on Hydrofluoric Acid Anhydrous. It provides helpful data for you if you now use HF or are considering its use.

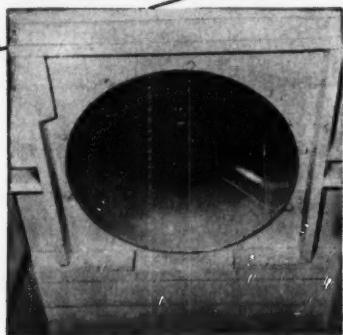


THE
HARSHAW
CHEMICAL COMPANY

CLEVELAND 6, OHIO • BRANCHES IN PRINCIPAL CITIES



JOY[®] AXIVANE FANS HANDLE SEVERE QUICK-FREEZE JOB



Left: Looking up from the quick-freeze room below a Joy Axivane Fan. Note the compact, economical use of space and the simple mounting.

A West Coast quick-freezing plant boasts an effective operation that utilizes 24 Joy 7½ HP Series 1000 Axivane Fans, installed in two groups of 12 each.

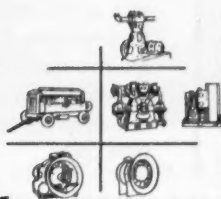
Note the illustration above. The upper floor contains freezing coils and a row of 12 fans. The floor below is partitioned into narrow freezing tunnels, each served independently by a single Joy fan.

As air passes through the freezing coils, it is cooled to between -30° and -35° . This sub-zero air is propelled down and through the tunnels below, which contain pallets of meat, vegetables, fruit, etc. to be quick-frozen. After passing over the food, the air is again cooled and circulated. At full plant load, each 12-fan battery handles 242,000 CFM of air.

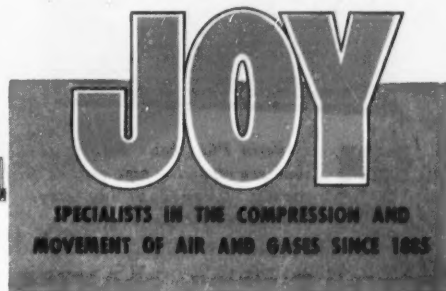
The relatively quiet operation, light weight, compactness and low power consumption of Joy Axivane Fans—due to the unmatched efficiency of their vaneaxial design—have proved *real* advantages on this job. Their in-line construction also saves space, since each fan can be mounted right in its short, vertical duct. In addition, extreme flexibility of operation is made possible by the adjustable blades, a standard Joy feature. ● Let us help you to get best results on your fan problems. Joy Manufacturing Company, Oliver Bldg., Pittsburgh 22, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

Consult a Joy Engineer

for Vaneaxial Fans . . . Compressors, Vacuum Pumps and Boosters . . . Oxygen Generators

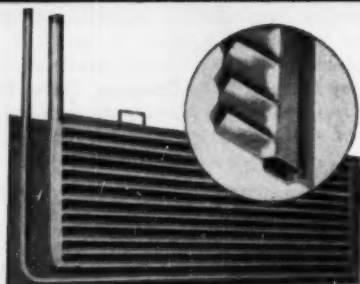


WBD 1-4406



PLATECOILS cured coil-itis* and tripled the capacity of this tank

At the tank pictured below at Continental Motors Corp., three crankcase sections can be cleaned at one time when Platecoils are used as the heating medium, while only one crankcase can be cleaned with pipe coils in the tank. Continental has also found that the high efficiency of the Platecoils provides fast heating for quick starts. Their flat surface coats less frequently and takes only about half the time to clean when it does.



Bulletin P61 shows how Platecoils are replacing pipe coils at a savings throughout industry. Send today for your copy.

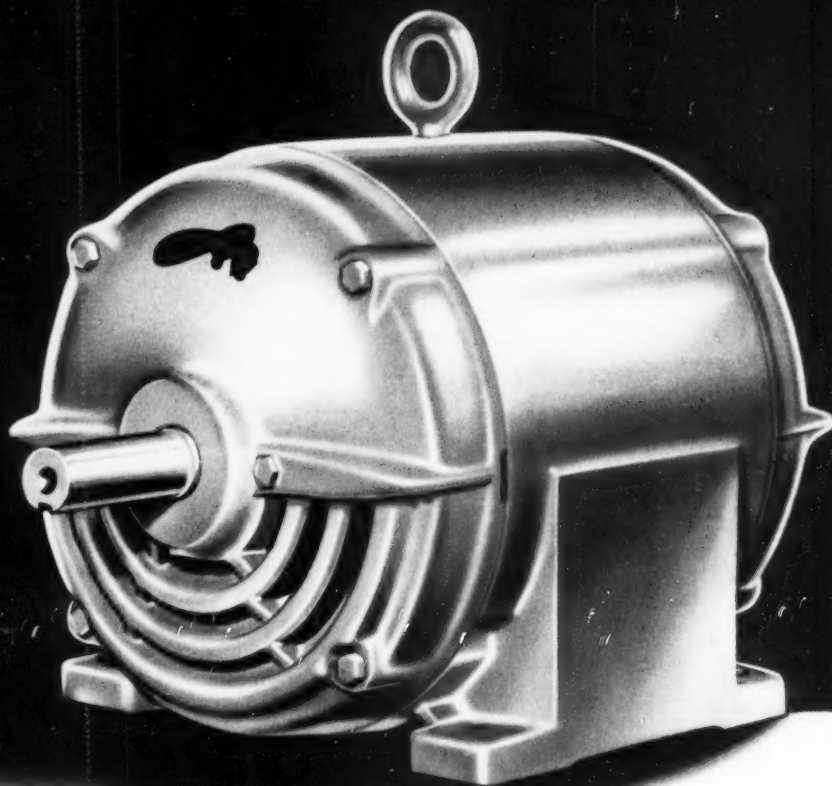
PLATECOILS replace pipe coils for 50% of the cost

* Coil-itis is the constant doctoring of wet processing tanks for pipe coil troubles. It can be cured easily by replacing pipe coils with Platecoils. Immediately, you will notice the difference as Platecoils put new life and profits into your heat transfer processes. They heat or cool 50% faster and take 50% less space in the tank. They save as much as 50% in initial cost and 50% in maintenance costs in addition to overcoming the limitations and operating difficulties of old-fashioned and outmoded pipe coils.

Platecoil Division, TRANTER MANUFACTURING, inc., Lansing 4, Michigan

Not just a "face-lifting" to meet the new NEMA standards,
but a completely redesigned motor line

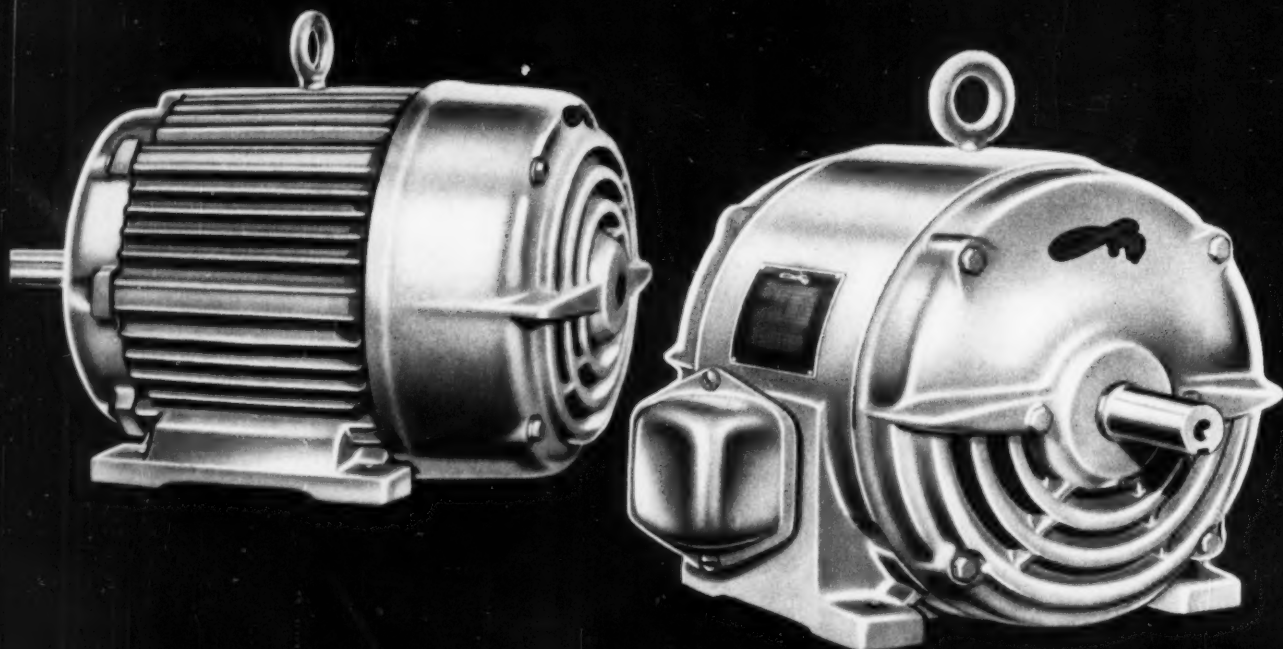
The Louis Allis Co.
proudly presents
the NEW L.A. Line
of electric motors



... the concentrated utilization of over 50 years of engineering and development
brings you this new concept in motors.

Please turn the page . . .

Here's new power for all
standard and special motor applications



▲ New L. A. Fan-cooled and Explosion-proof Motor

▲ New L. A. Open Drip-proof Motor

*From over 50 years of motor building experience and
many famous firsts including*

the first fan-cooled, explosion-proof motor
the first rapid-reversing motor
the first really splash-proof motor
the first screenless textile motor

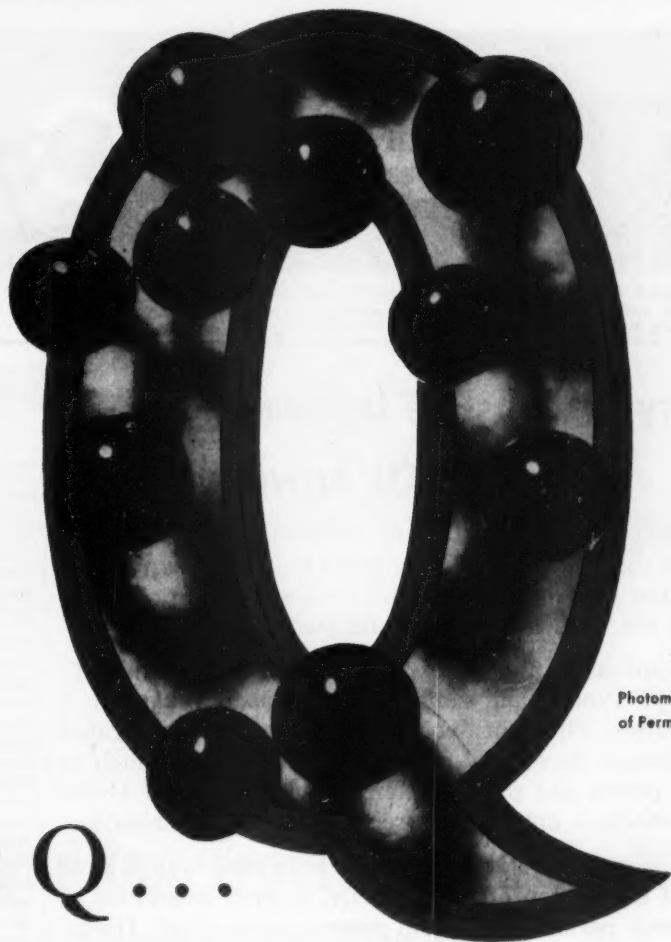
comes the **NEW**  *Line*

Here's the motor that's entirely new through and through, with such features as new modern styling...improved ventilation...greater protection...new conduit box arrangement...new bearing construction...and more versatile mounting. Get the facts on the most up-to-date motors available—

the new L.A. line. See how these new motors can provide more power in a smaller package for your product or plant...with the same high standards of Louis Allis performance, temperature ratings, service factors and torques. Call your Louis Allis Sales Engineer for the complete story.

***Special Note** Louis Allis motors, built to the same high standards of quality and performance in the old NEMA standard frame sizes, will still be available if you require them for interchangeability or replacement.*

THE LOUIS ALLIS CO. • MILWAUKEE 7, WISCONSIN



Photomicrograph
of Permutit Q

Permutit Q...

is a high capacity cation exchange resin

DESCRIPTION

Resin type... Sulfonated polystyrene
Appearance... Brown beads
Size... Av. diameter 0.7 mm
Weight... 50 lbs. per cu ft

PERFORMANCE

Exchange capacity... up to 30 kgr/cu ft
Flow rate... 8 gpm/sq ft
pH range... 0-13
Regeneration time... 60 to 75 minutes
Regenerant dosage... as low as 0.25
lbs. salt per kgr CaCO₃ removed

It can be a far cry from claims based on glass-tube results to full-scale plant performance. And we at Permutit know this well. For only Permutit manufactures both Ion Exchangers and Equipment... gets the full benefits from observing actual field performance.

Your certainty of best results lies in Permutit's knowledge of the whole life history of "Q". This enables us to constantly adjust manufacturing procedures to bring you a resin with continually improving characteristics... those which complete experience prove most desirable.

In a Permutit Demineralizer, "Q" helps produce water purer than distilled at a fraction of the cost. Demineralized water reduces rejects of porcelain insulators, produces more uniform plating finishes, helps many industries.

Other applications: demineralizing sugar to increase yield, purifying polyhydric alcohols, cutting phosphoric acid pickling costs up to 66%, saving a rayon producer \$500 a day by recovering copper from wastes, separating rare earths.

Perhaps this suggests profitable uses in your processing. We'll gladly send data and resin samples for your experimental work. Write to THE PERMUTIT COMPANY, Dept. CE-2, 330 West 42nd Street, New York 36, N. Y. or Permutit Company of Canada Ltd., 6975 Jeanne Mance Street, Montreal.

CATION EXCHANGERS

Permutit Q
Permutit H-70
Decalco®
Zeo-Dur®
Zeo-Karb®

ANION EXCHANGERS

Permutit S-1
Permutit S-2
Permutit A
Permutit W
De-Acidite®

ION EXCHANGE EQUIPMENT

Water Softeners
Demineralizers
Metal Recovery
Waste Treatment
Automatic Controls

Ion Exchange Headquarters for Over 40 Years

PERMUTIT®



DARCO

Digest

DARCO DEPARTMENT • ATLAS POWDER COMPANY
Darco General Sales Offices—60 EAST 42nd STREET, NEW YORK 17, N. Y.
ATLAS POWDER COMPANY, CANADA, LTD., BRANTFORD, CANADA

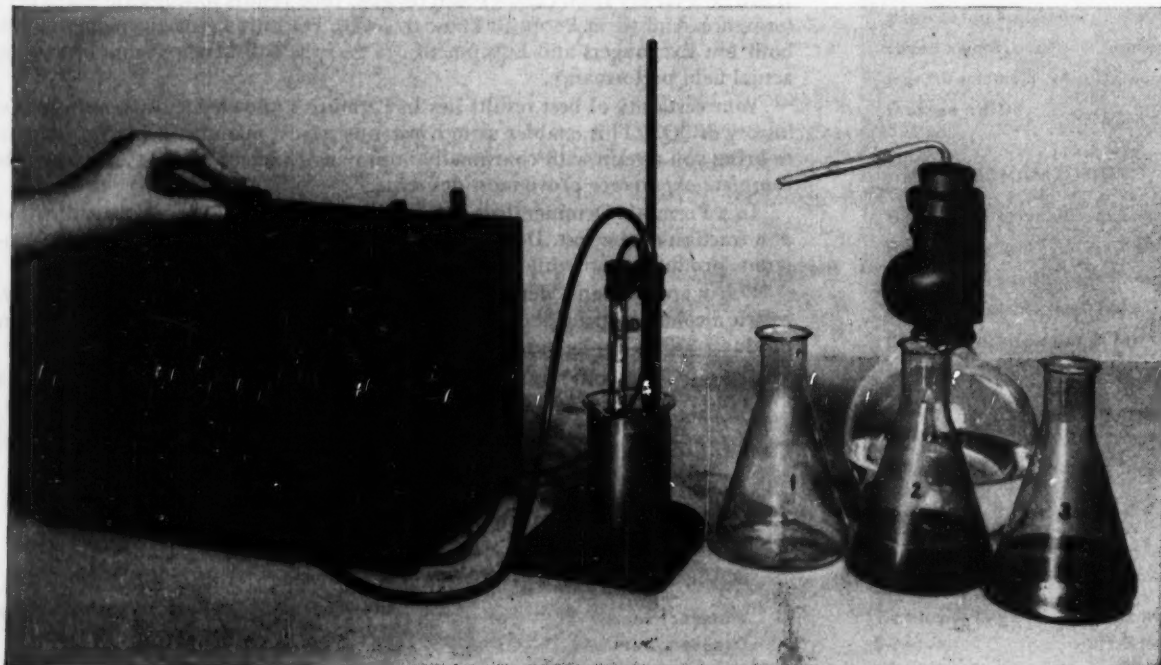
Laboratory Tests Assure Uniformity of DARCO Activated Carbon

The uniformity of Darco activated carbons is controlled by daily tests in the Darco laboratory. Rigid standards assure you that the Darco you receive, whether by the carton or by the carload, will not vary in efficiency and purity.

Most important of the daily Darco tests is the check on adsorptive capacity. Production samples are measured against a standard solution. They must come within five per cent of rated relative efficiency. Secondary qualities are also tested, such as filterability, purity and pH of water extract. Grades of Darco used for specialized applications receive further examination.

This strict quality control, through daily tests and through close regulation of every step of manufacture, is your guarantee of highly uniform performance from every shipment of Darco.

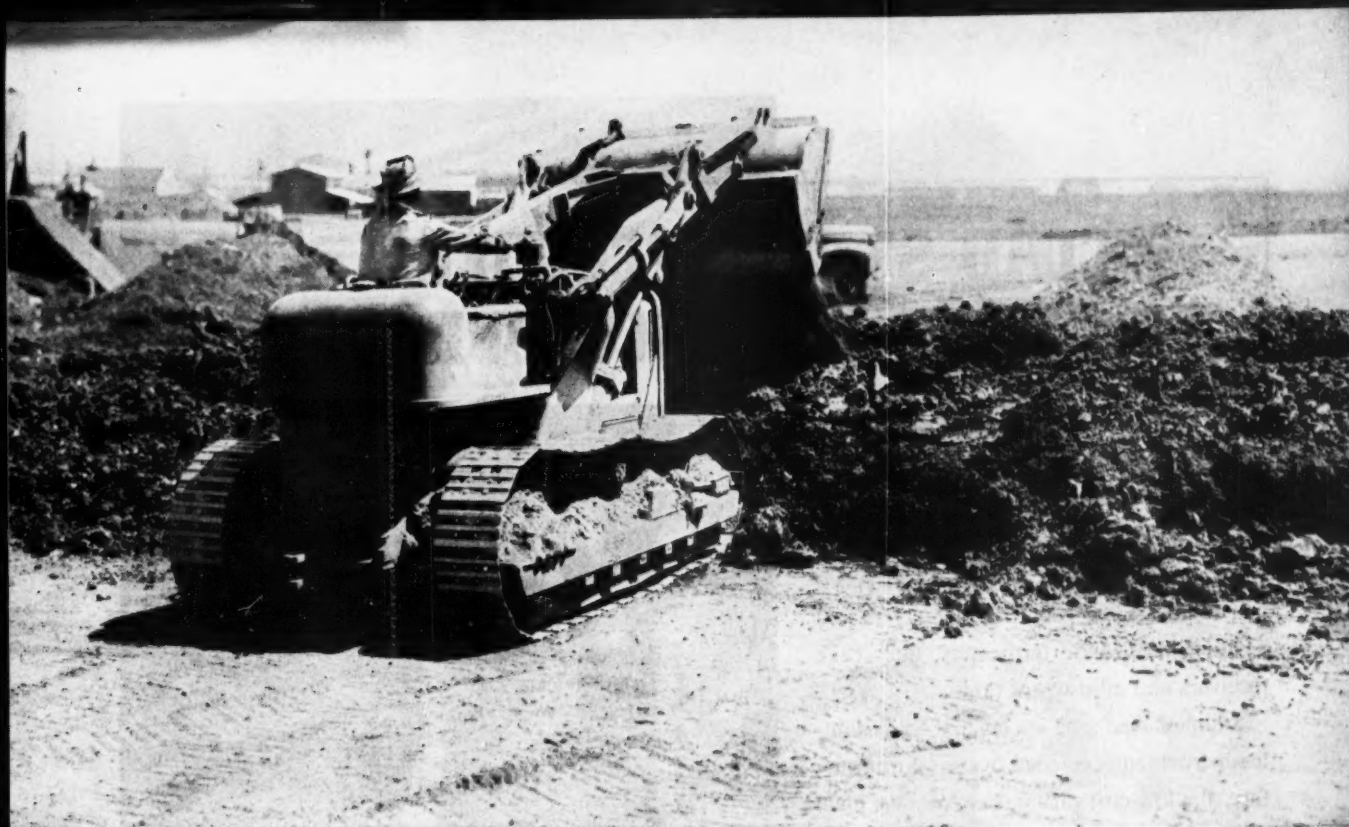
Laboratory technician at the Darco plant measures pH of water extract, as part of daily quality control testing.



Removing color traces from plasticizers

Water-white color and crystalline clarity are desirable characteristics of plasticizers. Especially when used with clear or lightly tinted grades of plastic, the flexibilizing agent must be free from trace colors which would introduce off-shades in the finished material.

Decolorizing these materials with activated carbon presents several problems. They are highly viscous organic liquids, and must be treated at elevated temperature to facilitate filtration. It is important to choose the correct grade of carbon to achieve economical decolorization. Retention loss in the carbon should be as low as possible, because this valuable product can only be recovered from the filter cake by blowing, not by washing. The carbon should also be chosen for its good filterability and for high adsorptive capacity in order to minimize the dosage required. Darco G-60, the premium quality grade, is often recommended for this application: its freedom from inorganic contaminants insures absence of haze in the plasticizer which might be caused by traces of calcium, or sulfates, in the carbon used for treating it.



How a Bulk-Handling Tractor Pays Its Way Even in a Liquid-Producing Plant

The Allis-Chalmers HD-5G Tractor Shovel is well known to industry for its efficiency on such jobs as loading, stockpiling, feeding hoppers and conveyers. But its usefulness is not confined to bulk-handling plants. For example, one large producer of flammable liquids finds that the HD-5G has more than paid its way for the past five years handling a wide variety of jobs.

DIGS TANK FOUNDATIONS

One of its duties is to help install new tanks. On this operation, the HD-5G does much of the excavating for foundations. Sometimes the size of the excavation or the presence of obstructions makes it necessary to dig by hand. In this case, the Tractor Shovel loads the excavated material into trucks.

BUILDS FIRE WALLS

Another important job assigned to the HD-5G is building fire walls around storage tanks. Earth for fire walls is obtained from nearby fields. Here the Allis-Chalmers Tractor Shovel strips and loads the earth into trucks. After trucks have delivered earth to the site, the HD-5G shapes and compacts the wall with its bucket and crawler tracks. From time to time it is necessary to remove fire walls for installation of new tanks. This, too, is handled by the HD-5G.

TEARS UP OLD ASPHALT

General plant maintenance also gets a hand from the

Allis-Chalmers Tractor Shovel. When it became necessary to rebuild plant roads, the HD-5G quickly ripped up the old asphalt and loaded it into trucks.

WORKS WITH INTERCHANGEABLE ATTACHMENTS

Because of its power, traction and versatility, the HD-5G is constantly called upon to handle non-routine jobs. The standard one-cubic-yard bucket is quickly interchanged with an eight-foot bulldozer blade. With this attachment, the HD-5G clears and levels land for new construction, builds or removes dikes around earthen settlement tanks and maintains unpaved yard roads.

Other interchangeable attachments for the HD-5G include an Angledozer Blade, Lift Fork for pipe, lumber or packaged loads, Trench Hoe for pipe laying and digging foundation footings, Crane Hook for moving heavy machinery and various buckets for rock, light materials and other specialized applications.

Ask your Allis-Chalmers dealer to show you how the versatile HD-5G can increase efficiency in and around your plant.

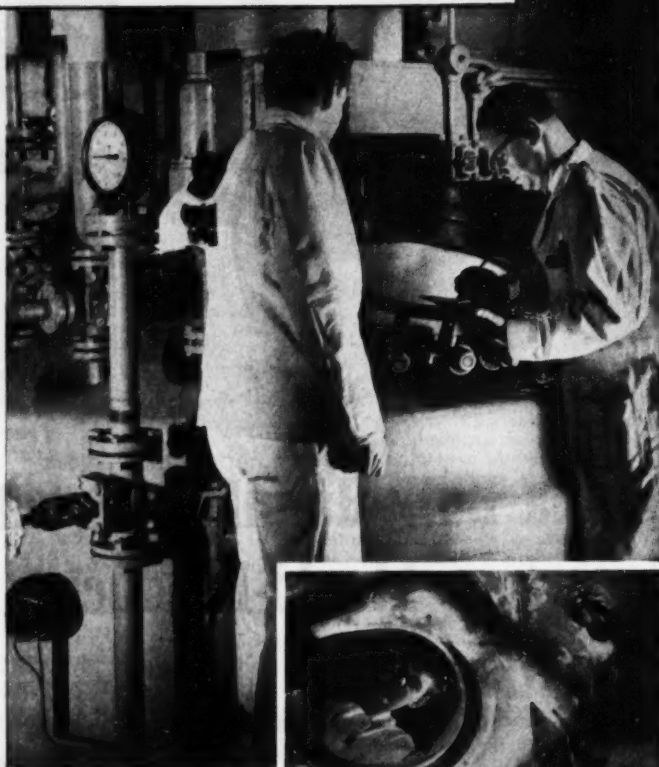
ALLIS-CHALMERS
TRACTOR DIVISION MILWAUKEE 1, U. S. A.

CLAD STEEL SPECIFIED TO GUARD PRODUCT PURITY

Even submicroscopic quantities of foreign bacteria or metallic pick-up are taboo in this antibiotics plant. To safeguard purity *economically*, stainless-clad steel was specified for the 5,000 gallon fermenter, as well as for intermediate fermenters, filter cake receivers and adjustment tanks.

Stainless-clad steel—a layer of solid stainless permanently bonded over its entire surface to a low-cost carbon-steel backing plate—does the work of costly solid stainless plate at considerable savings: polished interior surfaces protect product purity, guard against contamination, are quick and easy to clean . . . completely sanitary. Carbon-steel exteriors are economically painted, too, to help increase plant cleanliness and maintain an attractive appearance.

Whatever demands your processes place on tanks and pressure vessels—product purity, resistance to corrosion, high heat transfer—you'll find clad steel equipment means low first cost and long life. When you're planning new units, call your equipment builder in early. He can give you cost-saving suggestions, help your engineers design equipment to fit your particular needs.



Polished interior surfaces of clad steel vessels give *maximum* sanitation—at low cost—wherever product purity is essential.



Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 678 Lukens Building, Coatesville, Pennsylvania.



CLAD STEELS

STAINLESS-CLAD • NICKEL-CLAD • INCONEL-CLAD • MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

Your order for
Kaiser Alumina...



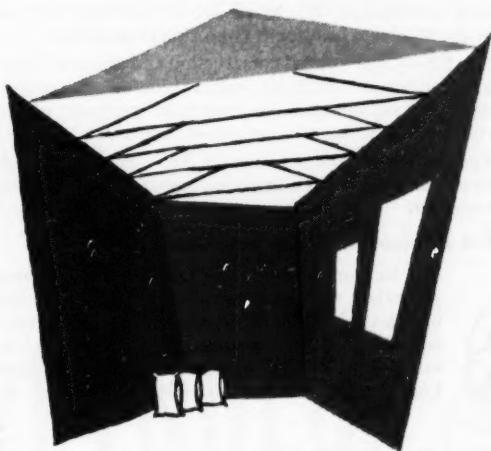
gets fast individual attention...



assuring immediate delivery...



often overnight, in emergencies...



thus reduces large, costly inventories.

This personal service—combined with unsurpassed quality and experienced technical assistance—has made Kaiser Chemicals a major supplier of calcined and hydrated aluminas. Today, we supply alumina to more than eighty per cent of the nation's users.

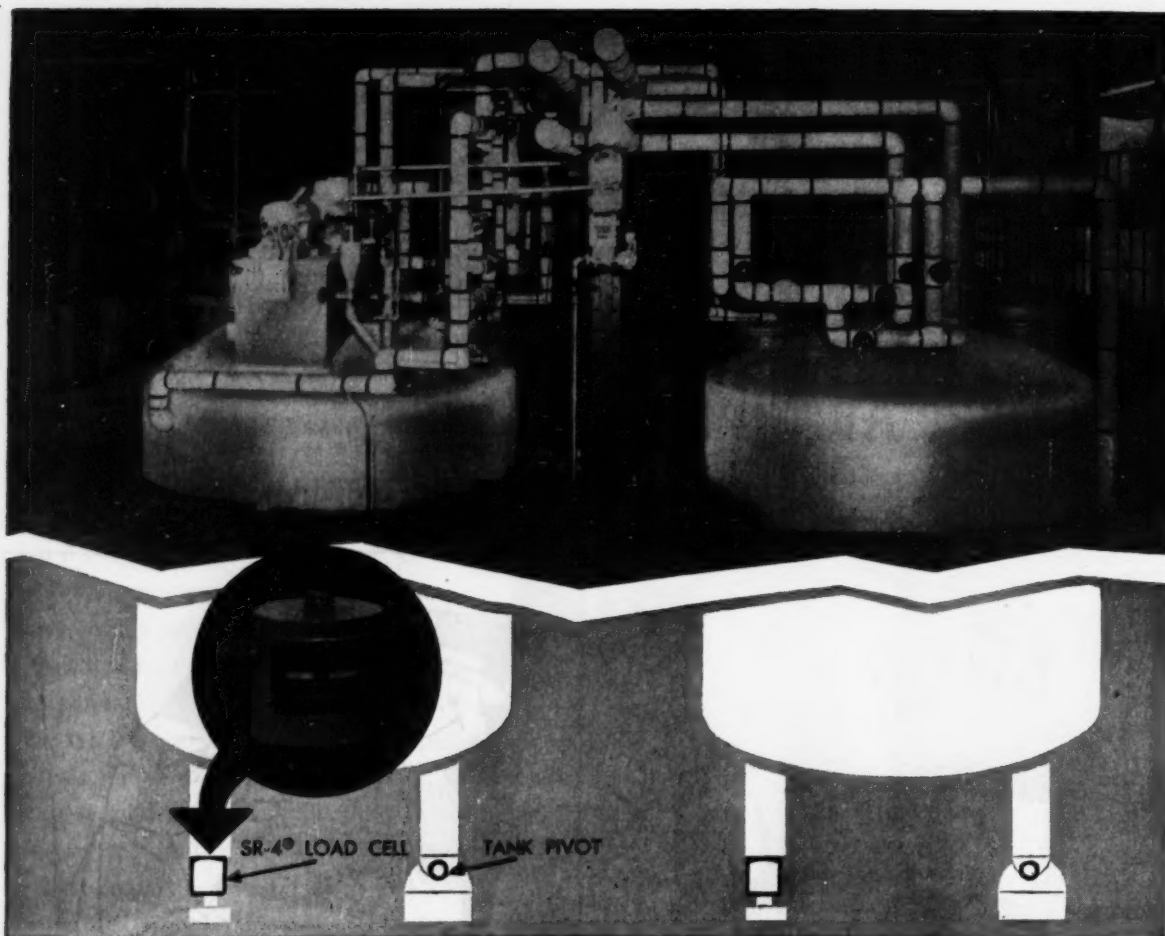
Whether you manufacture abrasives, glass, ceramics, refractories, catalysts, or chemicals for water treatment, we have the product and the service to meet your needs exactly. Contact principal sales offices: Chemical Division, Kaiser Aluminum & Chemical Sales, Inc., Oakland 12, California; First National Tower, Akron 8, Ohio.

Kaiser Chemicals

calcined and hydrated aluminas

Alumina • Basic Refractory Bricks and Ramming Materials • Dolomite
Magnesia • Magnesite • Periclase

See our complete listing in Chemical Materials Catalog



Baldwin SR-4® Load Cells Permit Remote and Automatic Control of Latex "Batching"

THE PROBLEM:

In order to weigh liquid latex directly in the processing tanks, this leading rubber company sought a method which would require very little head room, use a minimum of steel and control various steps of each batch with $\frac{1}{2}$ of 1% accuracy.

THE BALDWIN SOLUTION:

Every requirement was met by the installation of a Baldwin SR-4 weighing system. Each 2,000 gal. tank, holding 16,000 pounds of latex, is supported by three legs. Two of the legs have rod-end bearings and the third rests on one 10,000 pound SR-4 Type C Load Cell. As the tank fills, changes in its weight are transmitted by electric cables from the cells to a switching unit and an indicator-controller on the upper floor.

This system offers these benefits:

- It controls automatically the entire batching operation, providing lights and alarms for empty and full conditions of the tank. It also has adjustable controls

between empty and full for sizing each particular batch by controlling motorized valves.

- The SR-4 system made it unnecessary to use much steel during installation. The small size of the load cells meant that the available headroom (14 inches) was ample.

- The SR-4 Cells' rugged construction and absence of moving parts, combined with good instrumentation and proper engineering, have enabled this system to maintain constantly its inherent accuracy of $\frac{1}{4}$ of 1% of capacity.

- Due to the electrical nature of SR-4 cells, they could be located on one floor and the indicating-controlling instrument on another.

SR-4 Devices in Industry... Uses Unlimited

For measuring load, fluid pressure, or torque more accurately and economically Baldwin SR-4 devices have unlimited uses in industry. Write for our two new booklets on tank weighing (No. 4106) and crane scales (No. 4105). Address: Dept. 3104 Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Penna.



BALDWIN-LIMA-HAMILTON

Philadelphia 42, Pa. • Offices in Principal Cities • In Canada: Peacock Bros., Ltd., Montreal, Quebec

New!

Organic Free Alumina from Reynolds

Improve Your Products Without Increasing Your Cost

New, snow-white premium grades of Alumina Trihydrate are available at the same price you are now paying for commercial grades of Alumina Trihydrate.

Whiter than any other similar products now available, Reynolds Organic Free Alumina Trihydrates offer you an opportunity to make your present products better without increasing costs. Often you can actually cut manufacturing costs because these premium grade products require no oxidizing agents to give you pure white end products.

For further information on Organic Free Alumina Trihydrate, call the Reynolds Office nearest you, or write to Reynolds Metals Company, 2567 So. Third St., Louisville 1, Ky.



Special consulting service is available to help you solve your problems involving chemicals, shipping containers, processing, corrosion and construction—the staff of each Reynolds regional office includes chemical and other engineering specialists.

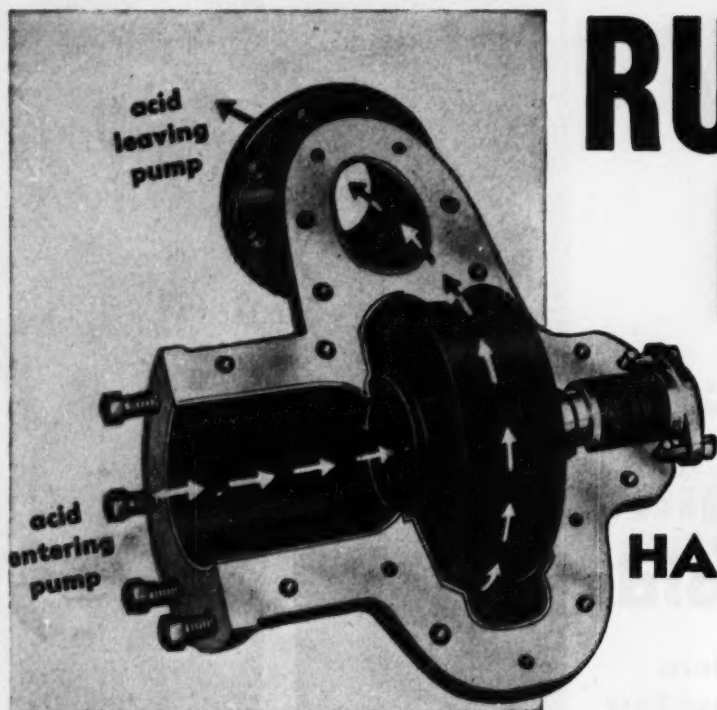
When further consultation is necessary, a fully integrated technical staff at headquarters is ready to show you how to save time, money and labor with Reynolds chemicals, mill products and shipping drums.

SEE "Mister Peepers" on Sundays, NBC-TV. Consult local listings for time and station.

REYNOLDS CHEMICALS

FROM THE PRODUCERS OF REYNOLDS ALUMINUM

CHEMICAL ENGINEERING—February 1954

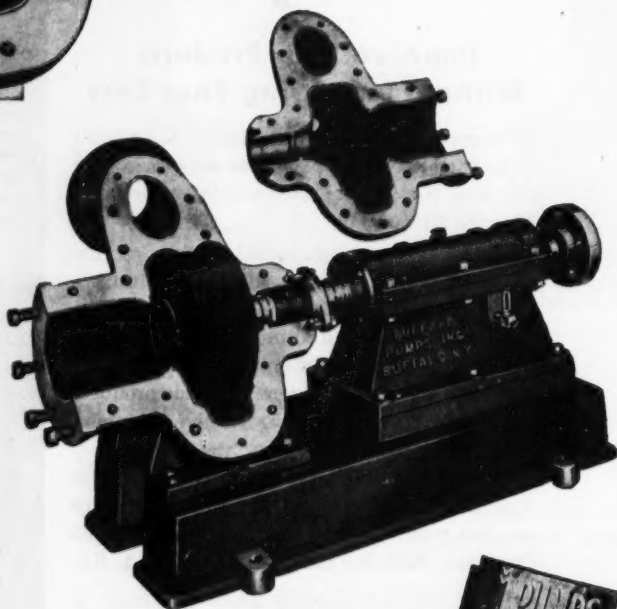


RUBBER LINING

CUTS ACID HANDLING COSTS

—IN THIS EFFICIENT, SERVICEABLE "BUFFALO" PUMP

Corrosive or abrasive-bearing solutions that would soon destroy ordinary pump impellers, shafts and casings are easily handled in this "Buffalo" Diagonally Split-Shell Chemical Pump! All parts in contact with liquid are bonded with the grade of rubber required for the liquid to be handled. Just one example of the wide line of Special "Buffalo" Pumps handling the vast group of liquids in the chemical industries at the lowest possible operating cost and the least possible maintenance. Whatever your conditions of corrosion, abrasion, temperature or hydraulic requirements, you'll find a "Buffalo" Pump tailor-made for that environment . . . one that will pay you in bonus years of dependable liquid moving!



Accessible for easy servicing! Showing how impeller, shaft and stuffing box are exposed by removing upper half of casing, without disturbing discharge piping.



WRITE TODAY for Engineering Bulletin 982 on our full line of Chemical Pumps.

BUFFALO PUMPS, INC.

501 Broadway

Buffalo, N. Y.

Subsidiary of Buffalo Forge Company, Canadian Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities.

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



Keith Fanshier

FROM NOW ON

TIME WAS in the petroleum industry when volume was the controlling factor in net profit. A volume increase would cure almost anything.

The industry was expanding rapidly. Costs were moderate. By a little ingenuity here and there cost increases could be offset. There was breathing-space.

Times have changed. Costs everywhere have soared, alarmingly. Prices of what the industry has to sell have been held down since wartime by government controls and by probably the most severe competition existing in any industry.

That easy breathing-space no longer is there. Things are tight, all along the line.

In these circumstances, volume alone is no longer the answer. No more can inherently unsound operations be cured or glossed over by an increase in volume. Larger volume in an unsound situation now will only complicate conditions.

Now even more than ever, for instance, will price wars accomplish nothing—nothing but waste, loss, worry and misery for participants, a reproach upon the industry, and a lower standard of service to public and nation. Also a lower "standard of living" for the oil industry.

The members of this oil industry are in a battle of survival with their costs. A pity of it is that some seem not to recognize the fact, or perhaps even don't know the true meaning of the term: costs.

One thing is sure: cost-consciousness will pay off in this year 1953. That's true of every single operation from the gleam in the eye of a geologist on a mountainside to the cut-off of the hose nozzle in the motorist's tank.

That should make possible a fair, compensating price structure. That will give this industry a reasonable profit, the public dependable service, the nation a fine contribution to security.

Who says costs are not important? They are this important. Their recognition and recovery is just about the most urgent problem this industry faces this year, and for a long future, if it wants to continue being an industry.

From now on it will take more than volume.

One of the most dramatic sources of economy in modern processing practice is the Ljungstrom Air Preheater. For details, consult The Air Preheater Corporation.

THE AIR PREHEATER CORPORATION

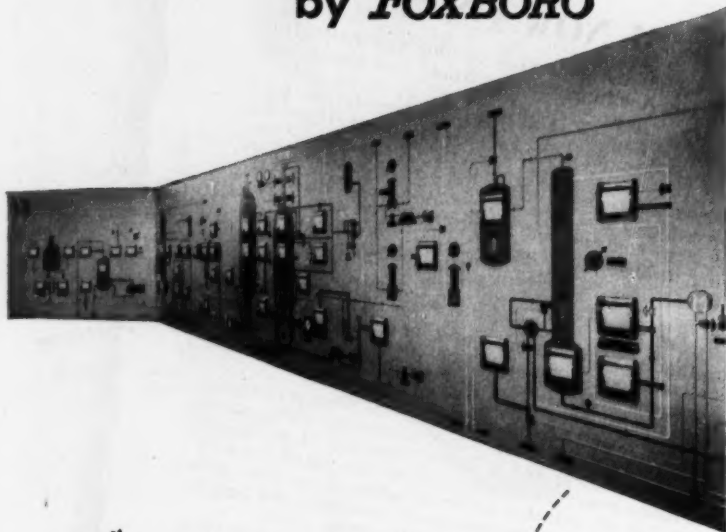
60 East 42nd Street
New York 17, N. Y.

Wherever you burn fuel, you need Ljungstrom

Follow the Leaders . . . specify

GRAPHIC PANELS

by **FOXBORO**



COMBINATION UNIT CONTROL PANEL for a Standard Oil Company (New Jersey) Affiliate. The panel makes full use of compact, full-visibility Foxboro Consotrol Recorders and Recording Control Stations located in the process diagram for easy operation and trend analysis.



Here and abroad, leading manufacturers are saving time and money by utilizing Foxboro's expert panel engineering facilities to provide them with Graphic Panels of outstanding efficiency and appearance.

Specialists in the field, Foxboro will engineer and fabricate a Graphic Panel exactly to your specifications—or will design one directly from your flow sheet. And they will recommend the most practical instrumentation and arrangement.

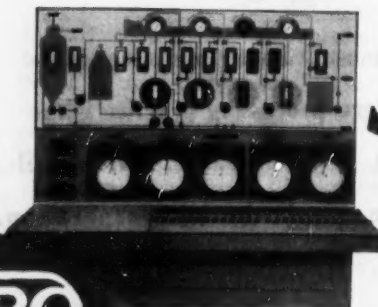
The Graphic Panels shown here are typical of the many now in operation throughout the world.

Write for detailed information on Foxboro Graphic Panels; also Bulletin 471 on Consotrol Instrumentation.

The Foxboro Company
362 Neponset Ave., Foxboro, Mass.



ALKYLATION UNIT CONTROL PANEL for Standard Oil Company of Ohio. Uses both Consotrol and standard size instruments. All critical controls are within immediate reach . . . all operating adjustments conveniently accessible from front of panel.



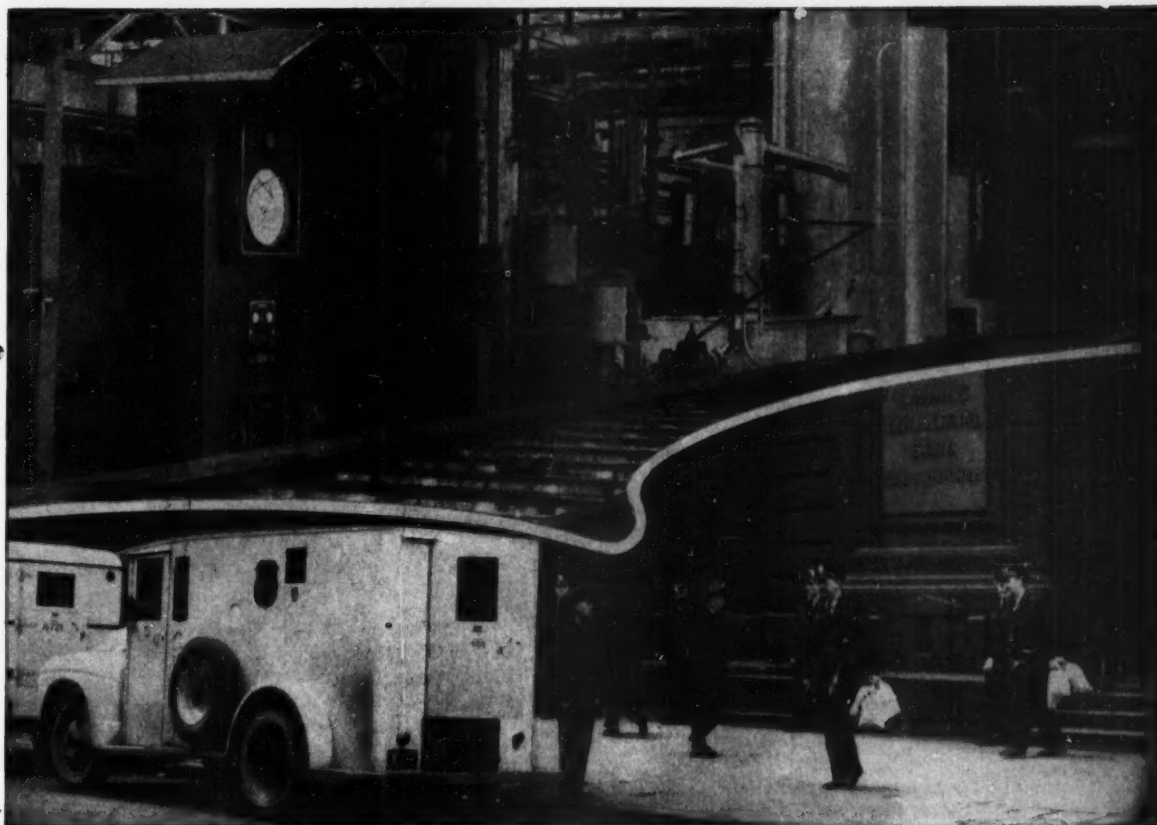
GRAPHIC PANEL for Gaylord Container Corp. controls four-stage vacuum pulp wash. Indicating type control instruments are located in the process diagram. Operation records appear on pneumatic 6-point Circular Chart Recorders located below related instruments in diagram. Normal and emergency operating controls and signal lights are neatly arranged on panel desk for easy identification.

FOXBORO

Reg. U. S. Pat. Off.

PRO

ING



Modern Safeguards—Brink's for Money, Bailey for Process Materials

Are Your Process Materials Guarded As Well?

HERE'S HOW TO PREVENT SPOILAGE AND WASTE...

TO avoid waste of valuable process materials and finished products, process rates and conditions must be accurately measured and controlled. That's where Bailey Meters, Analyzers and Controllers can help you to improve the efficiency of your plant.

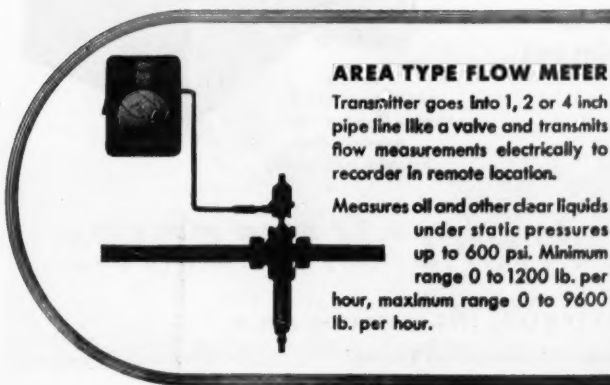
Take flow for instance. Bailey Meter Company offers a complete line of flow measuring and controlling equipment for applications ranging all the way from high pressure steam to low pressure gas. We measure

flow in pipes, open channels, ducts, furnaces, smelters, kilns, ovens, dryers.

When you call Bailey Meter Company, you get the help of years of experience as well as recommendations from a wide selection of measuring and controlling devices.

Your local Bailey Engineer is as near as your telephone. He has the experience and the equipment necessary to set up an effective guard for your process materials.

P-26



AREA TYPE FLOW METER

Transmitter goes into 1, 2 or 4 inch pipe line like a valve and transmits flow measurements electrically to recorder in remote location.

Measures oil and other clear liquids under static pressures up to 600 psi. Minimum range 0 to 1200 lb. per hour, maximum range 0 to 9600 lb. per hour.

BAILEY METER COMPANY



1054 IVANHOE ROAD
CLEVELAND 10, OHIO

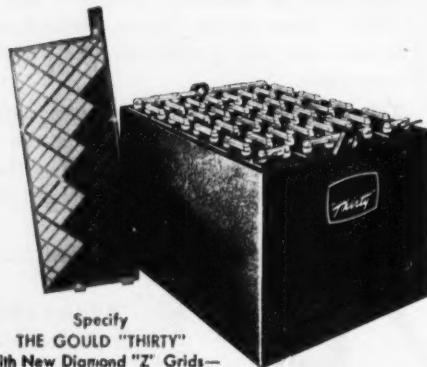
*Process
Controls*

TEMPERATURE • FLOW
PRESSURE • LEVEL
GAS ANALYSIS • RATIO



LASTING POWER for Handling . . . THANKS TO BATTERY POWER!

For the higher lifts and faster maneuvering required in today's handling operations, industrial trucks are a lot more rugged than they used to be. Batteries to power them are more rugged, too. Their increased capacity gives them lasting power to work longer, with greater reliability and at lower cost than with any other type of power. Only with battery power do you get the complete dependability, flexibility and adaptability to meet modern handling needs. There's *no* power like battery power. There's *no* battery power like *Gould* power!



Specify
THE GOULD "THIRTY"
with New Diamond "Z" Grids—
America's Finest
Industrial Truck Battery

GOULD INDUSTRIAL BATTERIES

GOULD-NATIONAL BATTERIES, INC., TRENTON 7, N. J.

Always Use Gould-National Automobile and Truck Batteries

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YOUR ASSURANCE OF *FIRST-TIME* AND *EVERY-TIME* DEPENDABILITY FOR FLAMMABLE LIQUID FIRES

JUST OUT—"Foam Fire Protection," illustrated booklet on what Foam is, what it does, how it works. Yours free.



EVERY BATCH of AER-O-FOAM is tested on actual petroleum or polar-solvents fires before it is offered to you. Each phase of the performance is checked—such as extinguishment time, foam volume and sealability.

AER-O-FOAM's tough blanket of tiny air-filled bubbles smothers and cools fire at the same time. What's more, it can be used to insulate surrounding property and equipment against fire damage. Write for data on AER-O-FOAM (for petroleum fires) and AER-O-FOAM "99" (for polar-solvent or petroleum fires). When you need foam fire protection, you need fire-tested AER-O-FOAM protection.

NATIONAL

FOAM SYSTEM INCORPORATED
Headquarters for Foam Fire Protection — WEST CHESTER, PA.

PROTECTS AGAINST CORROSION!

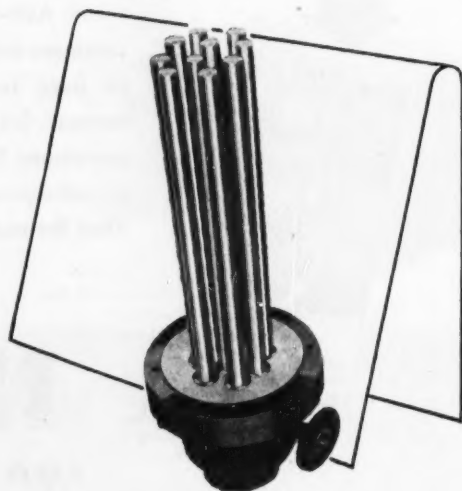
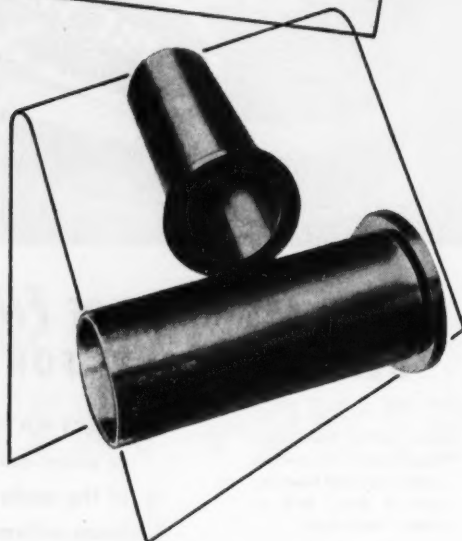
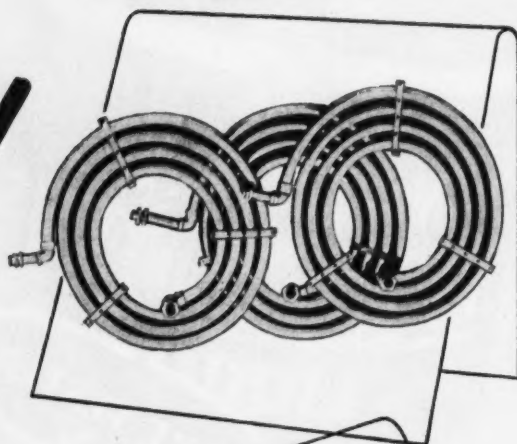
Platinum Clad...

... Makes the corrosion resistance of platinum available for industrial use at reasonable cost! Platinum Clad is pure platinum — or a suitable precious metal alloy — bonded throughout to a base metal support . . . It can be spun into desired shapes, drawn into seamless tubing or fabricated into shapes of interest to the chemical industry . . . The platinum thickness can be as low as .005" with assurance that the surface is free of pin holes . . . Remember — that the platinum values are recoverable so that unequalled corrosion resistance can be obtained for little more than the cost of other special alloy equipment.

Write for Booklet 96 giving complete details.

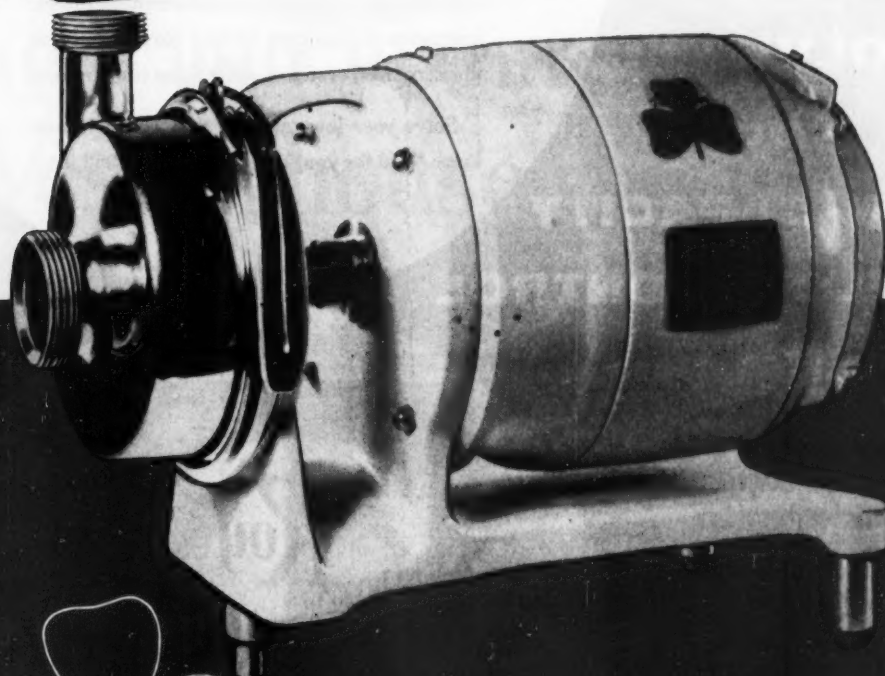
BAKER & CO., INC.

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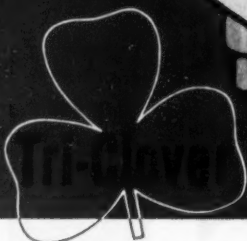




You Get More for Your Money



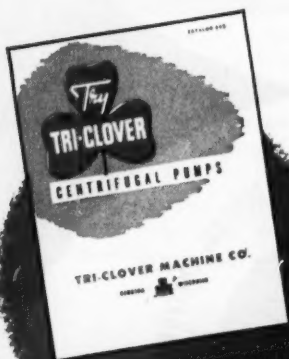
with Tri-Clover CENTRIFUGAL PUMPS



... and here are some of the reasons why: (1) *Wide choice of seal types, tested and proved for specific applications;* (2) *Design and manufacture that actually exceeds 3A sanitary standards;* (3) *Streamline heads—faster assembly and disassembly—easy to clean;* (4) *Patented impeller—higher efficiency—minimizes foaming action;* (5) *Pump heads can be turned full 360 degrees—simplifies installation.*

These are just a few of the advantages you get when you specify TRI-CLOVER Centrifugal Pumps. These modern, high efficiency units are backed by years of specialized experience, and are available in a full line of sanitary and industrial types to meet practically every corrosion-resistant pump requirement.

Let our experienced engineering staff help in solving your pumping problems.



Send for your copy of the new Tri-Clover Pump Catalog—the most complete pump book of its kind ever offered.

P254



TRI-ALLOY AND STAINLESS STEEL
SANITARY FITTINGS, VALVES,
PUMPS, TUBING, SPECIALTIES



THE Complete LINE

FABRICATED STAINLESS STEEL
INDUSTRIAL FITTINGS AND
INDUSTRIAL PUMPS

See your nearest
TRI-CLOVER DISTRIBUTOR

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CHICAGO, U.S.A.
Cable: TRICLO, CHICAGO

how to SOLVE your LOW-CAPACITY FLOW CONTROL problems

Q What are Controlled Volume Pumps?

A. Reciprocating, positive displacement, flow control instruments, driven by air or electric motor. They pump with a repetitive accuracy of plus or minus one percent. Capacities from 3 milliliters per hour to 45 gallons per minute. . . Pressures to 25,000 pounds per square inch. Capacity adjustment—manual . . . or automatic response to a control signal from an electronic or pneumatic control instrument.

Q Where are Controlled Volume Pumps Used?

A. Across all industry . . . for flow control and pumping of precise quantities of chemicals and slurries . . . for accurate rationing of chemical streams . . . and for automatic control of a process variable, such as pH, using these pumps as final control elements.

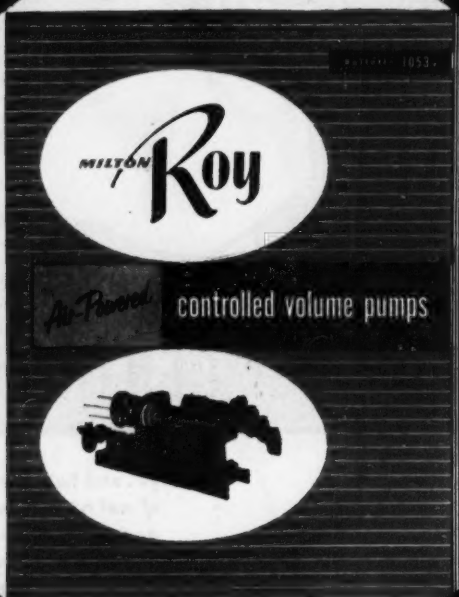
Q What is the Milton Roy Exclusive Step-Valve Liquid End?

A. A patented step-valve liquid end with individually inspectable ball checks (to facilitate cleaning). Sloping passages purge entrained air, assuring high repetitive volumetric efficiency.

Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

This new 16-page Bulletin 1053 on Air-Powered Controlled Volume Pumps is your guide to precise flow rate control of low-capacity chemical and slurry streams. It contains a graphic presentation of pump operating principles; capacity-pressure and air-consumption tables; examples of complete Milton Roy engineered chemical feed systems, using these instruments.

Solve your low-capacity flow control problems. Send for your copy of Bulletin 1053, now.



CONTROLLED VOLUME PUMPS ARE FLOW CONTROL INSTRUMENTS

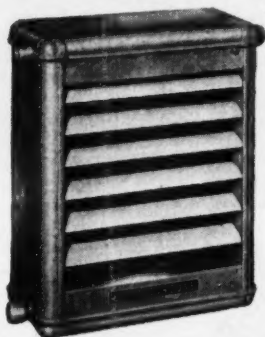
Roy

Manufacturing Engineers, 1000 MAID LANE • PHILA. 18, PA.
CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

Spot Heating?

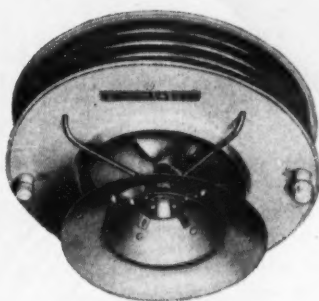
Complete System?

GET ALL 7 UNIT HEATING ECONOMIES WITH **Westinghouse SPEEDHEATERS®**



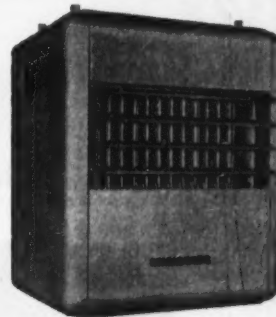
HORIZONTAL SPEEDHEATER

Get 7 to 8 times the output of conventional radiators. 11 standard sizes available for steam or hot water. Capacities from 17,800 to 300,500 BTUH.



DOWNBLAST SPEEDHEATER (with Multiple Cone Diffuser)

Delivers heat into working areas. 12 standard sizes for steam or hot water. Capacities from 25,000 to 400,000 BTUH.



GAS-FIRED SPEEDHEATER

Will run on low-cost natural, manufactured or LP gas. 7 standard sizes with capacities from 25,000 to 200,000 BTUH. Units have seal of approval of AGA Testing Laboratory.

TO ANSWER ANY UNIT HEATING PROBLEM, ONLY THE COMPLETE WESTINGHOUSE LINE GIVES YOU ALL THESE DOLLAR-SAVING ADVANTAGES:

1. **Instant, Low-Cost Heat**—where and when you want it without long, costly warm-up periods.
2. **Easy Installation**—all models equipped for simple hanger mounting. Minimum piping gives quick fit in tight spots.
3. **Any Application**—wide range of heating capacities—comfort or process—for spot heat or complete systems.
4. **Dependability**—heavy gauge, welded steel construction gives years of service under the toughest conditions.
5. **Design Efficiency**—adjustable louvers direct heat to working area, provide flexible heat distribution pattern.
6. **Quiet Operation**—efficient fan design gives top performance at low sound level.
7. **Dependable Westinghouse Motors**—Replacement motors available on exchange basis from Westinghouse stocking points across the country.

For full details on the Speedheater model best suited to your needs, call your nearest Westinghouse office for Catalogs 1521 (Steam and Hot Water) and 1525 (Gas-Fired), or write Westinghouse Electric Corp., Sturtevant Division, Boston 36, Mass.

WESTINGHOUSE SPEEDHEATERS

YOU CAN BE SURE...IF IT'S **Westinghouse**



... from billet

... to tube

... to fitting

GLOBE

Highly specialized process controls are used to produce the finest in seamless WELDING FITTINGS

Only Globe, among manufacturers of welding fittings, produces its own seamless steel tubes. Specialized processes at every stage of manufacture from billet to tube — to fitting — insure uniform high quality. Thorough inspection and continuous laboratory control guarantee strict conformity to rigid specifications.

Now . . . you can get these high-quality fittings when you need them — in the quantities you want. Just get in touch with your nearest Globe distributor.

GLOBE STEEL TUBES CO., Milwaukee 46, Wisconsin
Chicago • Cleveland • Detroit • New York • Philadelphia • St. Louis
Denver • Houston • San Francisco • Glendale, Cal.

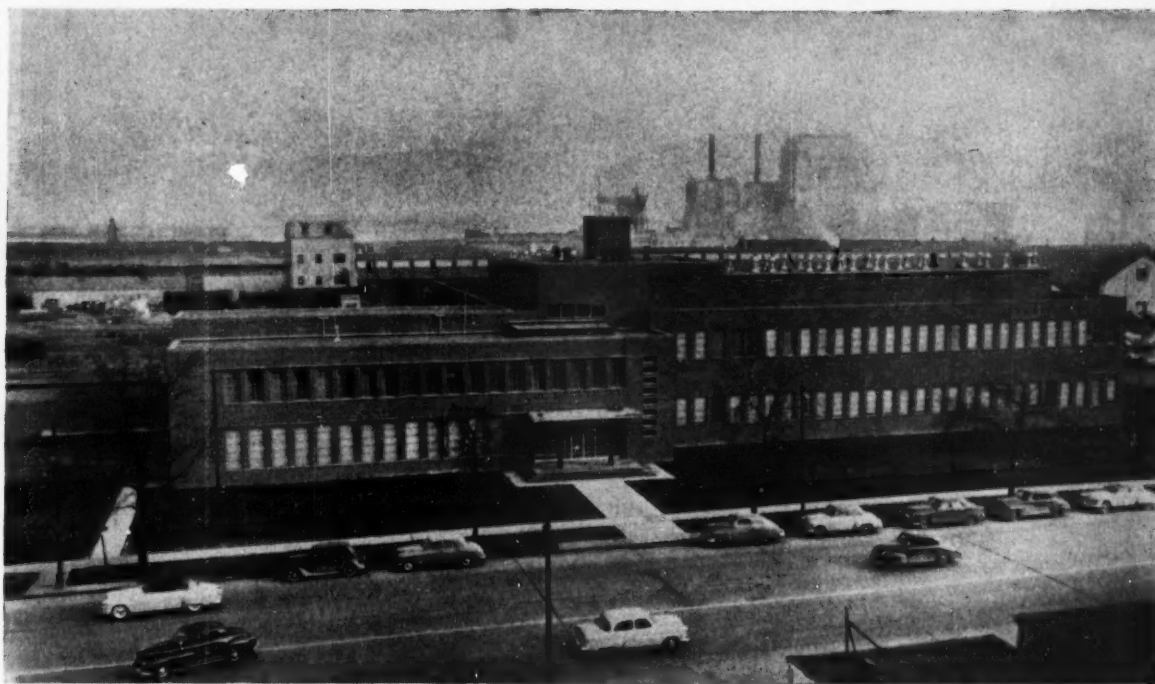
Producers of Globe Welding Fittings — Globe seamless stainless steel tubes — alloy — carbon seamless steel tubes — Gloweld welded stainless steel tubes — Globeiron (high purity ingot iron) seamless tubes.

AVAILABLE IN A COMPLETE LINE OF SIZES AND WEIGHTS THROUGH GLOBE DISTRIBUTORS IN ALL KEY CITIES



Here is one of the highly specialized manufacturing operations that insure Globe quality — piercing the billet to form a seamless tube.

Send for the Globe Welding Fittings catalog.



Wyandotte Chemicals Research Bldg. Architect: Stanton & Hillier. Consulting Engineer: George Wagschal Assoc. Contractor: Walbridge-Aldinger Co.

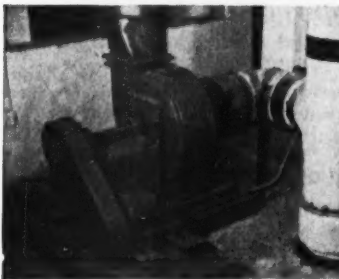
Better Air for tomorrow's chemical research

Wyandotte Chemicals Corp.
chooses American Blower equipment
for new multi-million dollar
research building

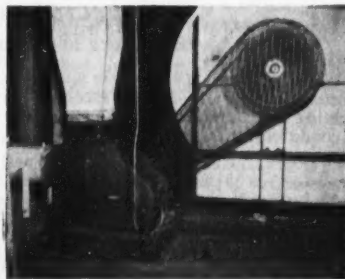


American Blower Series 81 Sirocco Fan. All Sirocco Fan ratings are certified in accordance with the Standard Test Code.

Air—the right kind of air, properly cleaned, conditioned and humidified—is a vital necessity in a modern chemical research laboratory. That's why Wyandotte Chemicals Corp. chose American Blower equipment for their highly functional new research building which has complete air conditioning in every laboratory. American Blower engineers have a complete knowledge of the air cycle and the special problems of many industries. Whenever you have an air handling problem give your nearest American Blower or Canadian Sirocco Branch Office a call.



Individual laboratory exhaust fans (rubber covered and corrosion resistant) have two speeds: slow for normal exhaust; high for experimental work. This allows the chemist to completely control room and hood ventilation.



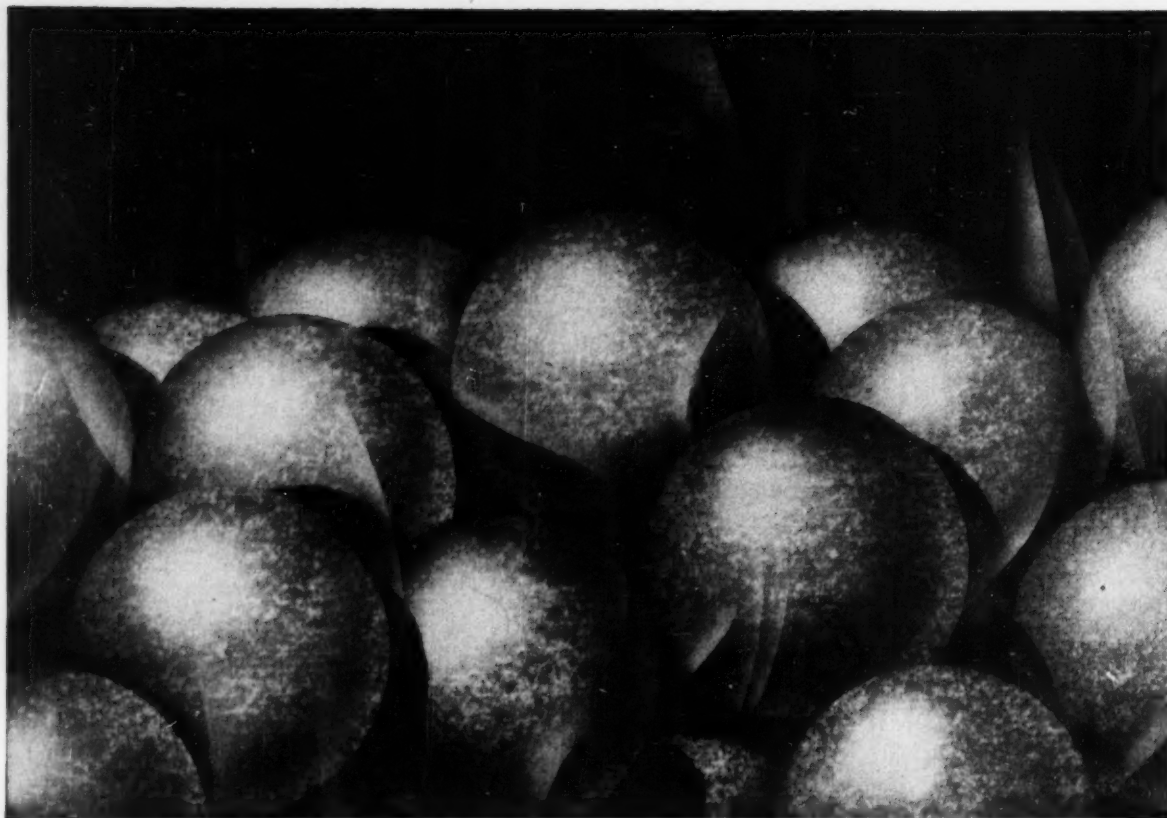
Secondary air is supplied by an American Blower HS fan with humidifier and dehumidifier, heating and cooling coils. Fan in foreground is American Blower utility set used to ventilate hard-to-reach areas such as stairways, etc.

AMERICAN BLOWER CORP., DETROIT 32, MICH. • CANADIAN SIROCCO CO., LTD., WINDSOR, ONT.
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEZ BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

CHEMICAL ENGINEERING—February 1954



Spheres "Bed" Perfectly in catalytic processing. In Norton Spherical Catalyst Supports you get uniform beds that promote uniform flow of

gases and assure minimum pressure drop. Spheres are available in sizes $\frac{3}{4}$ " to 1". Supports in Ring and Pellet form in sizes $\frac{3}{32}$ " to 1".

Catalyst supports to your special prescription

... Norton engineered for your special requirements

Where catalyst supports were applicable Norton engineers have been successful in meeting the requirements of a large variety of conditions.

Over 40 years' experience in research and developments of special refractory materials and mixtures have enabled Norton to tailor special refractory mixtures to meet the requirements of the chemical industry.

ALUNDUM® Catalyst Supports are a good example. They have such qualities as great refractoriness, chemical inertness, strength and high resistance to abrasive action. They are made by Norton's exclusive "controlled structure" process. It provides

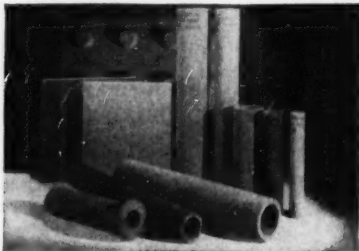
medium porosity of 30-35% with rough open structure for maximum adherence of catalyst, or high porosity 42-47% with large connected internal pores, uniformly dispersed for maximum deposition of the catalyst.

Test them yourself

See what Norton ALUNDUM Catalyst supports can do for you. If you would like to see samples, see your Norton refractories representative or write Norton Company, 501 New Bond Street, Worcester 6, Mass. Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.



Norton Exclusive Fused Stabilized Zirconia, an amazing material able to take temperatures double the melting point of most metals. No other refractory is so chemically stable at such high temperatures. (Up to 4700° F.) Ask for Bulletin 793.



Norton Exclusive. Norton ALUNDUM Seamless Tubes for filtration, aeration, diffusion maintain constant air or liquid pressure. ALUNDUM porous mediums also available in plates, discs and diaphragms. Ask for Bulletin No. 140.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

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ENGINEERED **R** PRESCRIBED

Making better products... to make other products better

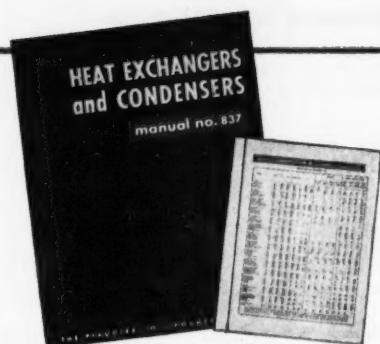
NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

now



FLEXIBLE STANDARDS

For Pfaudler Stainless
Steel Heat Exchangers



Pfaudler Data Book to help you save time on heat exchanger calculations

This 40-page, fact-packed manual is designed to help you solve heat exchanger problems. Contains all the data you need to work out capacity and type—arranged in easy-to-follow tables, curves and charts. Full details on Pfaudler heat exchangers. It's a basic working handbook which no one concerned with heat exchange should be without. Just mail the handy coupon for your copy.

Design features previously associated only with custom-built heat exchangers are now available at competitive standard cost under Pfaudler's new system of flexible standards.

For a given heat transfer area, you may select the most applicable combination of length and diameter. Further, nozzles can be of any size and in any position and can be either threaded or flanged. This flexible standards program applies to fixed tube sheet, single or multi-pass, tube and/or shell side stainless steel units in diameters up to 10".

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Under present conditions, flexible standard units can be delivered in from 4 to 8 weeks after the receipt of your order, always considering first our obligations under our country's allocation and ratings programs. Fastest deliveries are obtainable in the smaller sizes (4½" to 6"). These rapid deliveries are possible because we carry a stock of tube sheets, bonnets, nozzles, tubes, baffles, etc., ready for assembly to your specifications.

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ENGINEERS AND FABRICATORS OF CORROSION RESISTANT PROCESS EQUIPMENT

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No. 837

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Company

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Celanese[®] METHANOL

Celanese provides a uniform basic material with a purity not less than 99.85% Methanol

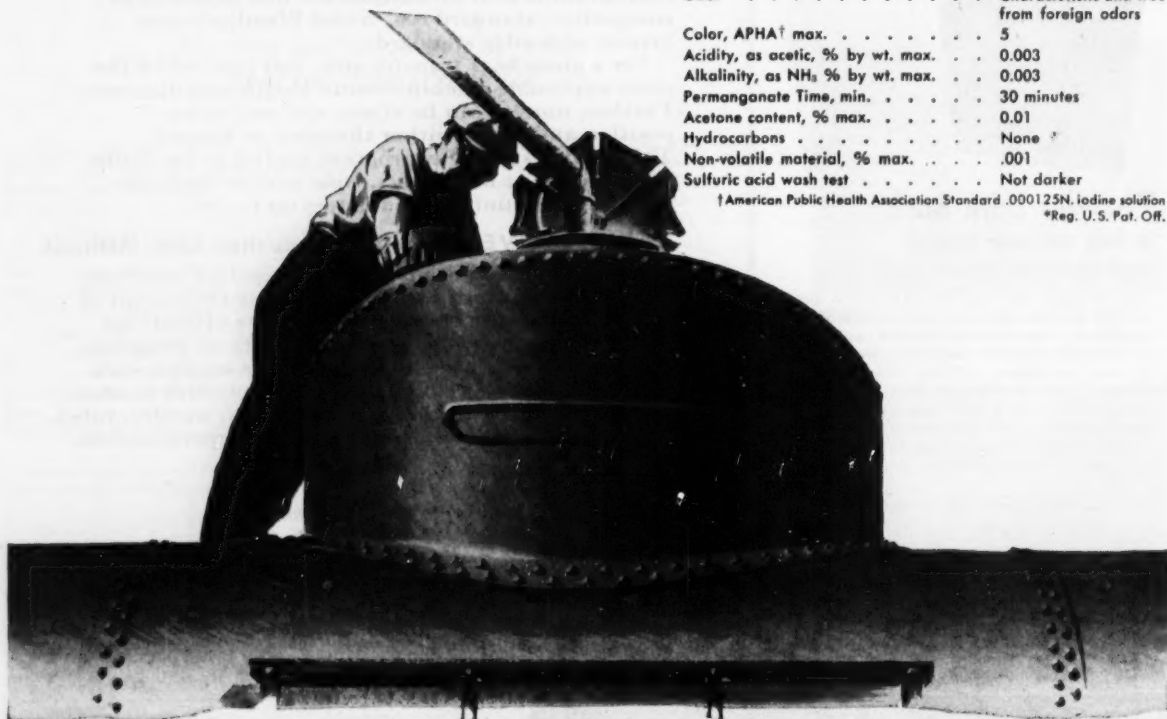
- ...the dependability of continuous volume petrochemical production utilizing abundant resources of natural hydrocarbons
- ...a nation-wide distribution system that includes bulk stocks in conveniently located terminals to assure rapid delivery
- ...the benefit of minimum inventory at minimum prices through combination shipments in compartmented tankcars, tank-trucks, or mixed drum carloads, with other Celanese Solvents, Plasticizers and Intermediates
- ...and the Technical Service and Applications Laboratories that can help to solve many raw material problems.

always on stream

Celanese Specifications

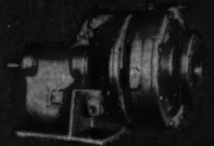




Methanol Content, % min.	99.85
Specific Gravity, max. @ 15/4°C	0.7962
Distillation Range, °C max.	1.0
Appearance	Clear and free of suspended matter in transmitted light
Odor	Characteristic and free from foreign odors
Color, APHA† max.	5
Acidity, as acetic, % by wt. max. . . .	0.003
Alkalinity, as NH ₃ , % by wt. max. . . .	0.003
Permanganate Time, min.	30 minutes
Acetone content, % max.	0.01
Hydrocarbons	None
Non-volatile material, % max. . . . .	.001
Sulfuric acid wash test	Not darker

† American Public Health Association Standard .000125N. iodine solution
*Reg. U.S. Pat. Off.



Celanese Corporation of America • Chemical Division • 180 Madison Avenue • New York 16, N. Y.

Find the Best Pump for Your Process Job Here—

	TYPE	APPLICATION	SIZE RANGE	SPECIAL FEATURES
 Frame Mounted: 5286351, 5286105 Close coupled: 5286083, 5286140	SSB Single suction Frame mounted Grease lubricated Also available close-coupled	General purpose use	Heads to 550 feet. Capacities to 3500 gpm. Temperatures to 250 F.	Available in many materials. Choice of packing, single or double mechanical seal. Bearings protect- ed from corrosive or abrasive atmosphere.
 5287638, 5286105 (Multi-stage)	SSB Single suction Frame mounted Oil lubricated	Chemical, petroleum and general purpose use in medium high temperature range	Heads to 550 feet. Capacities to 3500 gpm. Temperatures to 550 F.	Available in many materials. Choice of packing, single or double mechanical seal. Stuffing box cooled above 250 F.
 5287775	Refinery Type R Single suction Frame mounted Oil lubricated	Volatile liquids and high temperature proc- ess applications re- quiring heavy duty refinery type pump	Heads to 600 feet. Capacities to 1300 gpm. Temperature to 800 F.	Available in many materials. Choice of packing, single or double seals. Stuffing box, bearings, and pedestal may be water cooled.
 5286615	P and PD Single suction Frame mounted Grease lubricated	Handling fine abra- sives in suspension or corrosive liquids	Heads to 260 feet. Capacities to 1300 gpm. Temperatures to 250 F.	Stuffing boxes on suction side. Choose packing, mechanical seal or Equisal stuffing box — stops leakage to 15 foot suction head. Open or closed im- peller.
 5287112 (PW) 5286381 (CW)	PW — CW Single suction Frame mounted Grease lubricated	Handling slurries and pulpes which combine corrosive liquid with suspended solids	Heads to 270 feet. Capacities to 10,000 gpm. Temperatures to 250 F.	Available in many materials. Choice of packing or mechanical seal. Easy to dis- assemble for inspection or repair.

Complete Pumping Unit with Undivided Responsibility

HERE'S what you can get from Allis-Chalmers: Complete pumping unit — pump, drive, motor and control — ready to install and run. You save installation time. All parts are of coordinated design...built to run together. You get one dependable guarantee of satisfaction for complete installation.

Equisal is an Allis-Chalmers trademark.

Your nearby Allis-Chalmers District Office representative will be glad to help you with your process pumping problems. Or for complete information on Allis-Chalmers pumps for the chemical industry, write for the bulletins indicated in the table above.

Allis-Chalmers, Milwaukee 1, Wis.

ALLIS-CHALMERS





WITH *McQuay* YEAR-ROUND AIR CONDITIONING

PROVED AND PREFERRED...a complete line!

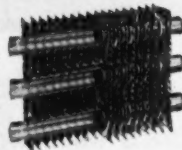
You're assured of comfort in any season when you install McQuay year-round air conditioning. McQuay products are proved and preferred—for their efficiency, economy of operation, and the way they stand up under long hard use.

Join the growing list of architects, engineers, and contractors who depend upon McQuay to satisfy all of their heating and air conditioning requirements.

Consult the McQuay representative in your territory or write McQuay Inc., 1622 Broadway St. N.E., Minneapolis, Minnesota.

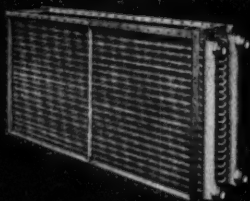
FAMOUS RIPPLE-FIN CONSTRUCTION

Ripple-fin coil construction is the product of years of research aimed at producing the ultimate in heat transfer for any weight

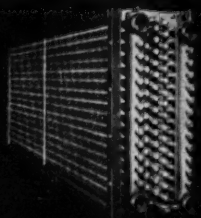


metal. High efficiency is assured by forcing the air to follow an ever-changing direction of flow in passing through the coil. Thus the air repeatedly contacts coil surface to give maximum contact time, maximum contact velocity and a resultant optimum heat transfer. The staggered tube and rippled edge features, so well known to the industry, contribute greatly to higher heat transfer, construction ruggedness and eye appeal.

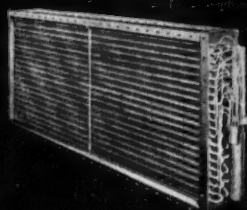
AIR CONDITIONING COILS



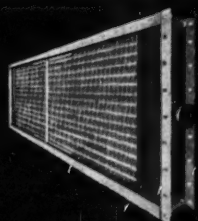
For Cooling and Heating,
1 to 10 rows deep.



Removable Plug Type,
1 to 10 rows deep.



For Cooling, 1 to 8 rows deep.

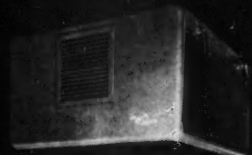


In 1 or 2 rows deep,
using low or high pressure steam.

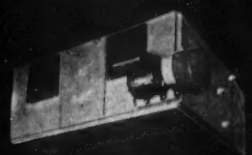
AIR CONDITIONING UNITS



Also available in basic or ceiling
types, 3 sizes, 200 cfm,
400 cfm and 600 cfm.



4 sizes, 2 to 10 Ton Models
For use with hot or cold water,
steam or direct expansion.



Type "AC" Central Station Air
Conditioners in 14 sizes for
industrial and commercial
applications.



Type "AC" Central Station Air
Conditioners in 14 sizes for
industrial and commercial
applications.

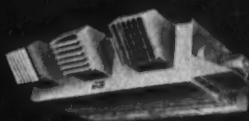
UNIT HEATERS



24 sizes with Nominal Capacity
range 20,300 to 360,000 Btu's.



22 sizes with Nominal Capacities
from 25,400 to 500,000 Btu's.



20 sizes with Nominal Capacities
from 20,600 to 1,600,000 Btu's.



20 sizes with Nominal Capacities
from 20,600 to 1,600,000 Btu's.

McQuay INC.
1622 BROADWAY ST. N. E., MINNEAPOLIS, MINNESOTA



HEATING
AIR CONDITIONING
REFRIGERATION

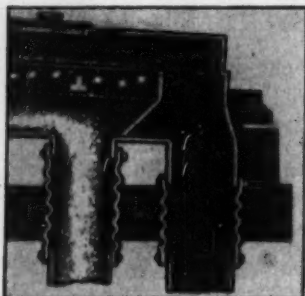
DAY

means longer life span



DAY Special Stainless Steel Ro-Ball Sifters at A. E. Staley, Decatur, Ill., showing only a part of the complete installation.

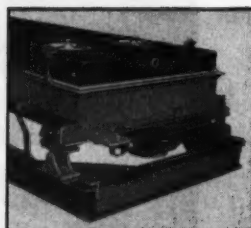
*Extra long life for your equipment is assured by DAY's unmatched ability to combine rugged construction with precision engineering. An impressive list of users have found this true of the DAY Ro-Ball Sifter, which accomplishes 100%



SUPER-ACTIVE BALL CLEANING DEVICE

elimination of foreign material and ideal aeration. Key to its outstanding performance is the Super-Active Ball Cleaning Device. Scores of rebound points are provided in each compartment, resulting in even vibration over the entire screen surface. The extremely fine mesh stays clean and open, allowing free passage without crushing or forcing.

Dust-proof Inspection Ports, with cast aluminum rim and cover, are precision-fitted. For complete information on these and many other features — including self-aligning tail end bearings, stabilizing drag link, and stabilizer to prevent rocking—simply call your nearest J. H. Day field engineer or write us direct for Bulletin.



SELF-ALIGNING TAIL END BEARINGS

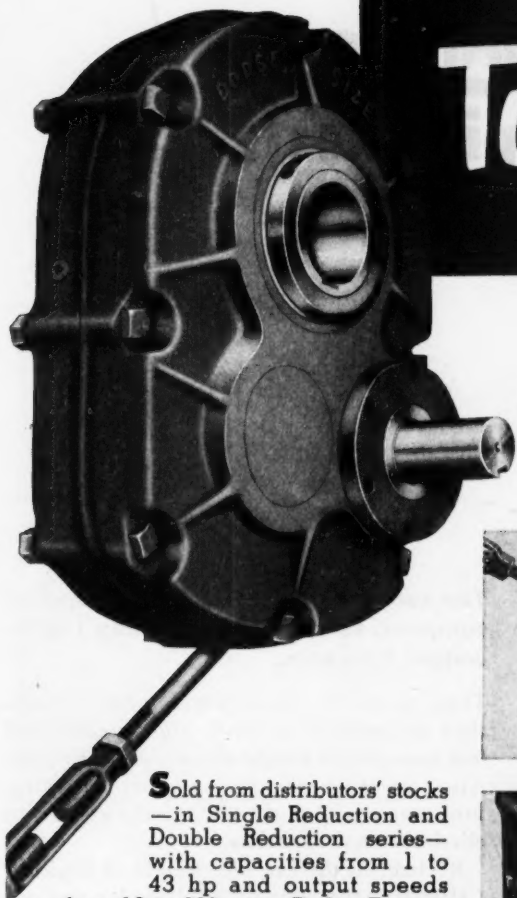
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THE J. H. DAY COMPANY
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PRODUCERS OF QUALITY EQUIPMENT FOR BAKING • PAINT & VARNISH • CHEMICAL RUBBER • PHARMACEUTICAL • COSMETICS • PAPER & PULP • EXPLOSIVES • FOOD CERAMICS • CANDY • SOAP • SUGAR • MILK PRODUCTS • OTHER MAJOR INDUSTRIES



Torque-Arm

The Most Complete Line of Shaft-Mounted Speed Reducers!

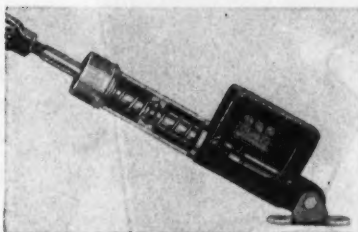
Sold from distributors' stocks—in Single Reduction and Double Reduction series—with capacities from 1 to 43 hp and output speeds from 12 to 330 rpm—Dodge Torque-Arm is the new and modern idea in speed reducers.

No special engineering required. No foundation to provide. No flexible couplings. No sliding base. No lining up difficulties. No expensive installation. Stock Taper-Lock sheaves prescribed for each job to provide desired speeds. Application to other machines is practical and easy.

Unit is driven through any V-Belt Drive. Torque-Arm, fastened to any fixed object, anchors the reducer unit. Turnbuckle provides fast and accurate adjustment of belt tension.

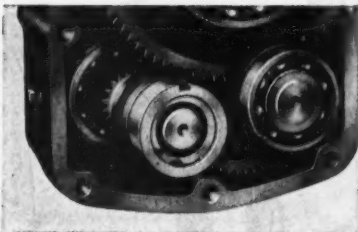
Standardize on Torque-Arm, the speed reducer that saves you money.

DODGE MANUFACTURING CORPORATION
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TRI-MATIC OVERLOAD RELEASE

Provides instant, positive protection for driven machines, motors and reducer itself. Automatically (1) loosens the belts, (2) cuts off power, (3) gives a warning.



TORQUE-ARM BACK STOP

Available from stock when required. Easily installed—sealed inside reducer housing. Simple, positive action prevents reversal.

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CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory-trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone book.



ROLLING GRIP AND
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TAPER-LOCK SHEAVES,
SEALED LIFE V-BELTS



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TAPER-LOCK
FLEXIBLE COUPLINGS

NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY,
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You can pare tare weight by shipping compressed gases in Hackney Light-weight Cylinders.

These seamless cylinders weigh less because they are made of selected, high-quality steel that assures light weight and adequate strength. Also, the Hackney process of cold drawing produces uniform sidewall thicknesses that eliminate excess material.

Remember, the low tare weight of Hackney Cylinders saves shipping dollars for you not only on out-bound shipments—but also on the return of empties. Hackney Cylinders are uniform in size and weight—uniformly easy to handle—uniformly durable for trip after trip. Made in many sizes—for high-pressure or low-pressure shipment of all types of gases. Send for further information.

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Glycerine *is the* *Emollient*



Daggett and Ramsdell, Inc. has used U.S.P. Glycerine as an ingredient in its "Perfect" Hand Cream since 1933. Glycerine is used in this famous beauty preparation for its emollient and hygroscopic properties. By retaining moisture, Glycerine prevents shrinkage of cream in the jar.

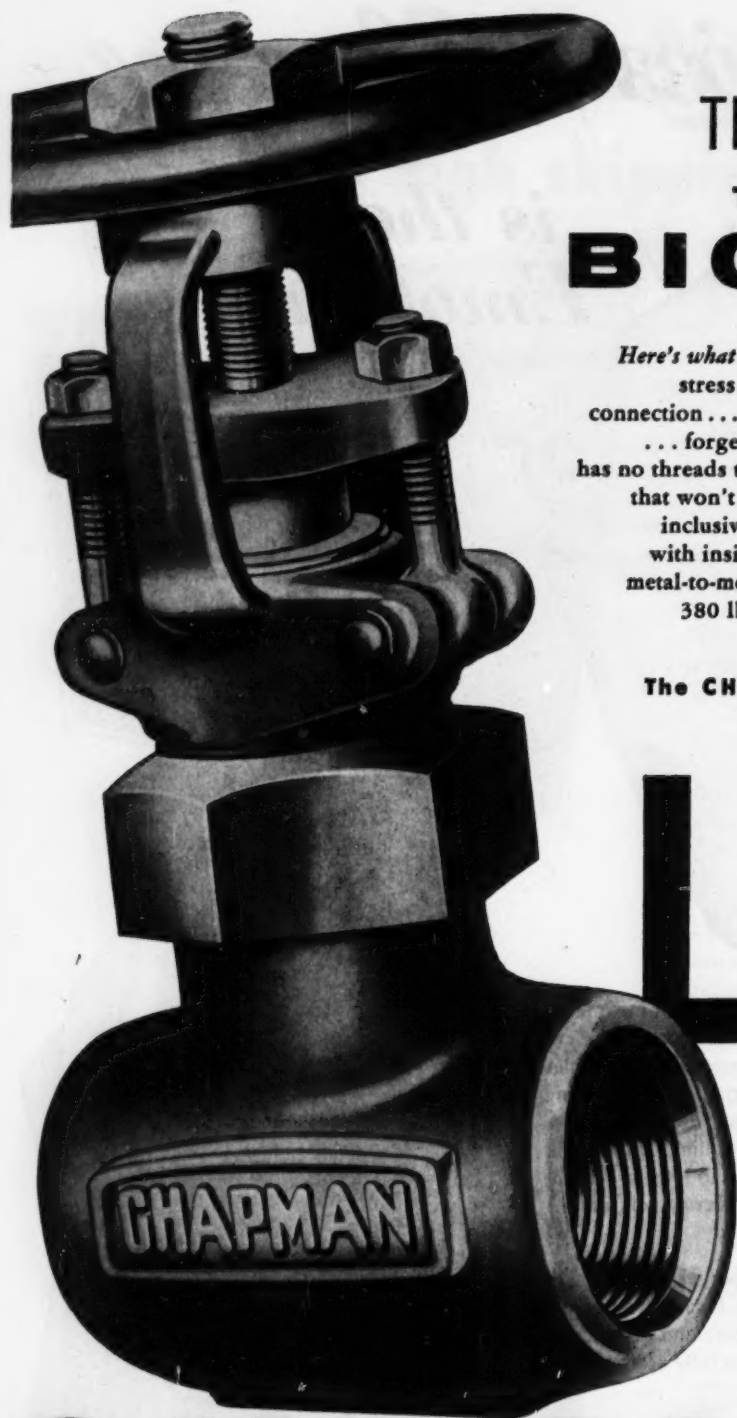
In the manufacture of oil-in-water emulsions—essential to the vanishing type of cream such as hand creams, face creams, and brushless shave creams—Glycerine is a favorite ingredient. It permits a smooth application of the cream and prevents "rolling" on the skin. It preserves the creams and lotions in good condition. Finally, Glycerine acts as a soothing agent to the skin.

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For the asking, we'll send you a 16-page booklet, "Why Glycerine for Drugs and Cosmetics?" detailing Glycerine's unique range of properties and applications. Write Glycerine Producers' Association, 295 Madison Avenue, New York 17, New York.

Nothing takes the place of Glycerine





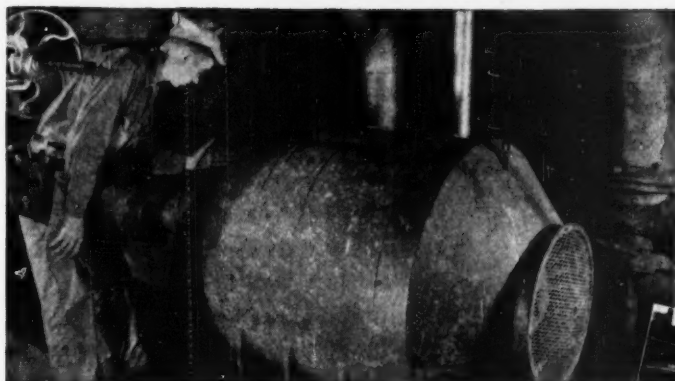
The Small Valve THAT DOES THE **BIG JOB**

Here's what you get: Extra protection against excessive stress with new extra-strong stem and wedge-gate connection . . . super-hardened seat rings of stainless steel . . . forged body and yoke (and bolted follower that has no threads to corrode) . . . plus Malcomized gate faces that won't seize or gall. Made in sizes from $\frac{1}{2}$ " to 2" inclusive, with choice of rising stem with yoke, or with inside screw. Bonnet joints either gasketed or metal-to-metal. Pressure range: 2,000 lb. at 100°F. — 380 lb. at 1,000°F. For higher pressures, specify List 990. Write for Catalog 10.

The CHAPMAN VALVE MFG. COMPANY
INDIAN ORCHARD, MASS.

LIST 960

CHAPMAN



**Totally-Enclosed
Fan-Cooled
MOTORS**

INDOORS or OUT

**DIRT and
CORROSION**



Can't Hurt These Motors

Here is a totally-enclosed type of motor that will solve many of your dirt and corrosion problems. Install anywhere, indoors or out.

Cooling System is Self-cleaning

Cooling air is carried through the heat-exchanger tubes with sufficient velocity to expel practically any kind of dirt. If oily or sticky dirt should cling, tubes can be ramrodded clean in a few minutes because tubes are straight and tube ends are exposed.

Choice of Corrosion-resistant Materials

You can lick corrosion with this motor, too. Tubes are available in a variety of materials to meet practically any corrosive atmospheric condition. Allis-Chalmers tube-type motors have long and successful experience in such difficult applications as caustic plants, refineries and petrochemical plants, power plants with fly ash problems and many others.

Next time you need a motor for a dirty or corrosive location or for outdoor operation in all kinds of weather, call your Allis-Chalmers District Office. Get complete information on Allis-Chalmers tube-type totally-enclosed, fan-cooled and explosion-proof motors. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B7149. Available in ratings on frames larger than NEMA 505 up to 3000 hp.

A-4222

Texrope and Vari-Pitch are Allis-Chalmers trademarks.

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CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE V-belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.



PUMPS — Integral types from 3/4 in. to 72 in. discharge and up.



ALLIS-CHALMERS

SPRAY A CADDY with *White Wash?*



TYGON Paints are blends of chemically inert plastic resins and balanced solvents which quickly air dry leaving an extremely tough, flexible, chemically resistant film — a virtually impenetrable barrier against most acids, alkalies, oils, alcohols, fresh and salt water. They can be applied cold by spray gun or brush. Colors—white, black, gray, green, red, aluminum and clear.



It makes just about as much sense as trying to protect expensive process equipment with a protective coating bought because it was pennies cheaper in the can.

It can be dollars dearer in your plant when it fails to *protect!*

Corrosion-Resistant TYGON Plastic Paint — not an ordinary paint — has a proven record of success against all forms of corrosion (corrosive fumes, condensates and spillage) since it first became available commercially in 1939.

We know that TYGON Paint is an excellent protective coating, but like everything else in this world, TYGON, too, has its limitations. Our literature tells what these are. We know also that when applied with reasonable care, under the many conditions for which it is suitable, TYGON Paint *out-performs* and *out-lasts* practically any other coating.

A suggestion — write for your free copy of Bulletin 750 which includes the performance record of TYGON Paint with over 175 *corrosives* — acids, salts, alkalies etc. Then if you think TYGON Paint may be the answer to your corrosive problems, buy a trial quantity and *test* it.

You will investigate TYGON Paint eventually, why not *today?* Address Plastics and Synthetics Division. The U. S. Stoneware Co., Akron 9, Ohio.

*plastics
and
synthetics
division*



U. S. STONEWARE

AKRON 9, OHIO

227-D

THE Chemementator[®]

Prepared under the direction of Joseph A. O'Connor, News Editor

• Eyeing the new market in rockets, jets and other atomic-age weapons, Carborundum Co., Firth Sterling and American Electro Metal Co. have joined forces in research on high-temperature materials. They are furnishing patent rights and technical know-how to newly organized Borolite Corp., which is doing research on heat-resistant metallic compounds known as borolites.

• From a low-cost byproduct of its production of chemical cellulose via ammonia pulping Rayonier, Inc., will make a new non-cellulosic chemical extract at its Hoquiam, Wash., mill. A light, fluffy, coffee-colored powder, the extract will go to a new industrial outlet.

Australia will produce uranium oxide

Pure uranium oxide will soon be produced commercially in Australia. Refined uranium oxide has already been made in a pilot plant at Radium Hill in South Australia. A large refining plant of U.S. design will be erected at Rum Jungle in the Northern Territory of Australia, and commercial production is expected to start in the second half of 1954.

The U.S. Atomic Energy Commission shipped the refining plant from the United States as part of its plan to cooperate with Australia in the exploitation of its uranium deposits. Cost of the plant will be paid by selling uranium to the United States.

Large deposits of uranium have been discovered at Rum Jungle. Ore is currently being stockpiled until the refinery gets into operation. U.S. experts will help to install the plant and start it running.

Previously, ore had been shipped to the United States, principally to determine the kind of plant needed to treat the Australian uranium ore. Ultimately, the complete refining process will be carried out in Australia.

Industry experts to study Bureau of Mines

The U.S. Bureau of Mines, which not long ago ran into controversy over its proposals for producing fuels and chemicals via two-stage coal hydrogenation, is about to have its over-all operations scrutinized by a non-government survey team.

Each industry affected by the work of the Bureau will have one man on the team. The group will seek to determine how efficiently the Bureau is working—whether it is confining its activities to the proper sphere without overlapping into the work that industry should do itself, and whether reorganization is needed. The

team's recommendations will go to Secretary Douglas McKay of Interior.

Ammonia process has high-pressure reformer

Design innovations developed by M. W. Kellogg Co. are incorporated in the new ammonia plant of Shell Chemical Corp. at Ventura, Calif.

An unusual feature of the process is a reforming step that takes advantage of the high pressure at which natural gas is available. By conserving the potential energy of the feed, synthesis gas is produced at relatively high pressure. Although the synthesis gas must be still further compressed before it is charged to the ammonia converters, the new high-pressure reformer saves 25 to 35 percent in compressor horsepower.

The reformer operates at about 100 psi. Effect of the new design is economy in operation without loss of reaction efficiency.

A special reactor designed by Kellogg also helps to improve ammonia yields and to lower operating costs of the process. The new Kellogg converter, which employs layers of catalyst with an efficient means of cooling the gases in between, closely approaches the ideal point-by-point temperature control. A near-isothermal condition results in the reactor, leading to longer catalyst life, lower maintenance cost and higher conversion per pass. The Tuscola, Ill., plant of National Distillers, which Kellogg is building, will also use this improved reactor but not the reforming step.

Here's how Kellogg's ammonia process works. Natural gas is fed into a reforming furnace where about 70 percent of it is converted into raw synthesis gas. This mixture is then charged to a combustion chamber where nitrogen in the form of air is introduced into

(Continued on page 106)

The Chementator, continued

the stream. The heat of combustion of the oxygen in the air supplies the energy to reform the rest of the natural gas and to elevate the gas to 1,700 deg. F.

Leaving the combustion chamber, the mixture immediately enters a vessel in which it is quenched directly by water. This not only brings the temperature down to that required in the shift reactor but also provides the steam for the shift reaction.

Next comes gas purification in which the first step is the shift reaction. This converts the CO in the stream to CO₂. Simultaneously, H₂ is produced as a result of the reaction with water in the form of steam.

Carbon dioxide is next removed by a regenerative MEA system. This method of removing CO₂ has five advantages: (1) no oxygen contamination; (2) negligible synthesis gas loss; (3) essentially complete removal of CO₂; (4) production of pure CO₂ ready for use; and (5) compactness of equipment.

After this purification operation, traces of carbon monoxide in the stream are removed before passing the synthesis gas through oil separators where it mixes with a recycle stream from the primary separator. Thence, it passes through the secondary separator, which knocks out ammonia contained in the recycle. The synthesis gas is then passed through exchange and charged to the catalytic converters.

Product gases from the converters are cooled in water coolers and then by exchange with converter feed gas in the recycle gas exchangers. Anhydrous liquid ammonia is separated out in the primary separator and, after further cooling to 25 deg. F. in a refrigeration system, goes to an anhydrous product flash drum.

Wanted: new titanium producers

Government money, roughly \$75 million, is being lined up to boost the nation's capacity to produce primary titanium up to almost 35,600 tons annually by 1957. That's way more than double the 13,200-ton capacity now scheduled to be in place at that time.

The General Services Administration expects to sign contracts advancing these funds for new plants and equipment. Companies most likely to land them: Du Pont, Titanium Metals Corp. of America, Monsanto and Dow Chemical.

Du Pont and Titanium Metals already have GSA contracts. The new agreements will be patterned after these. In addition to cash advances against future production, the deals will include market guarantees on output, fast tax writeoffs on plants and equipment, and a proviso cancelling a company's indebtedness if equipment becomes obsolete during the life of the contract.

This is an eventuality most experts anticipate, since the companies will all employ modifications of the high-cost Kroll process. This is a batch process in which titanium tetrachloride is reduced to metallic

sponge by reaction with molten magnesium. Price of primary titanium produced this way: \$5 a lb.

However, many companies, among them Union Carbide & Carbon and Kennecott Copper, are rushing work on lower-cost continuous processes. Carbide's Electromet is supposedly going to put up a plant in the Niagara Falls area, using a sodium reduction. Kennecott Copper likewise has its own process, highly regarded by government experts. But Kennecott at present seems least likely of potential producers to get a government contract. Kennecott's raw material would be the high-titanium slag from the Sorel, Quebec, operations of its subsidiary Quebec Iron & Titanium, of which it owns two-thirds. Kennecott's partner in Quebec Iron & Titanium, which owns the other third, is New Jersey Zinc, possessor of one of the best electrolytic processes for making titanium.

Monsanto, another of the likely new producers, might use the batch Kroll process at first, but it may also have a reduction process that substitutes sodium amalgam for magnesium. And meantime Monsanto and National Research Corp. are still at work on the electrolytic route. Horizons, Inc., and many other companies are also seeking an effective electrolytic process.

Any of these new producers, such as Electromet or Kennecott, might be able to start operations with one of these lower-cost continuous processes in the near future. Such a producer might be willing to put up private capital, but would still want Washington's other production incentives.

Meantime, current production of titanium is lagging seriously. Total 1953 commercial output was only about 2,400 tons produced by DuPont and Titanium Metals. There was also some meager tonnage from the laboratories of the U.S. Bureau of Mines and from privately owned pilot plants. Production in 1954 is supposed to reach 5,500 tons.

Both the Air Force and the aircraft manufacturers, working through a Senate subcommittee headed by Senator George Malone, the Nevada Republican, have ruffled their feathers so much about the titanium shortage that something had to be done.

Attempting to sign contracts with new producers is only a first step. Director Arthur S. Flemming of the Office of Defense Mobilization has called for a special inter-agency committee to develop immediately a government program for titanium expansion. The new titanium committee will be headed by an industrialist or scientist who will become, in effect, the titanium czar. One of the first decisions he can be expected to make is to lift the expansion goal far higher than even the new 35,000-ton target.

Sulfur from sour gas in Wyoming

A large gas processing and sulfur recovery plant will be built in north central Wyoming. A group of oil companies, including Socony-Vacuum, Gulf, Stanolind, (Continued on page 110)

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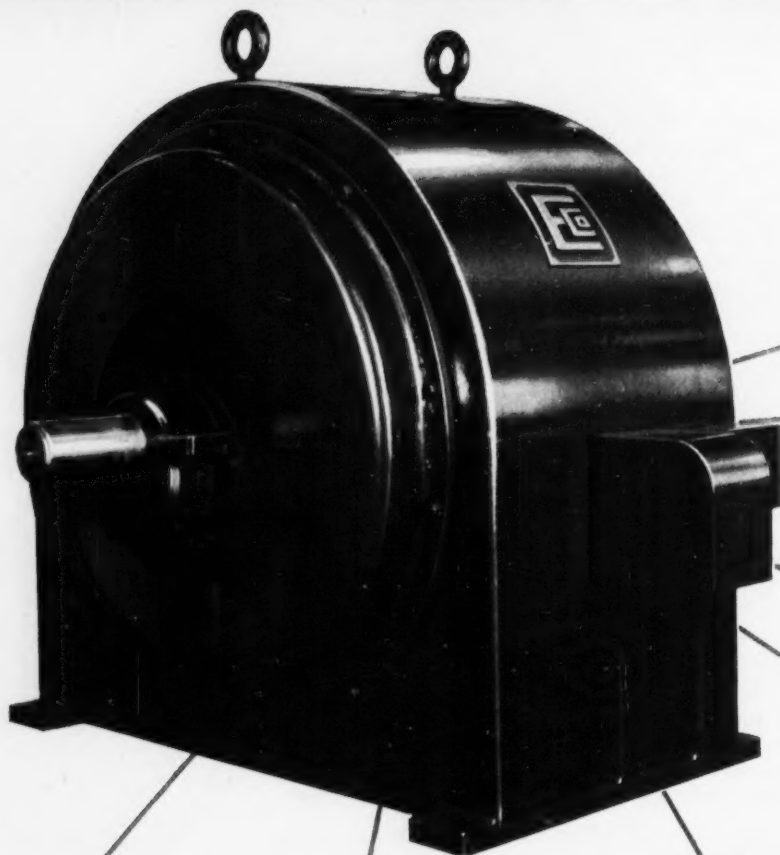


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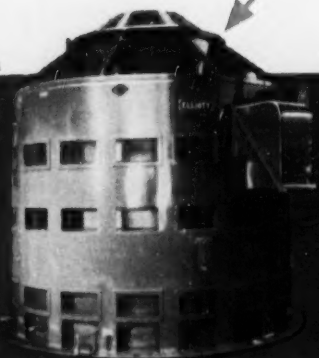
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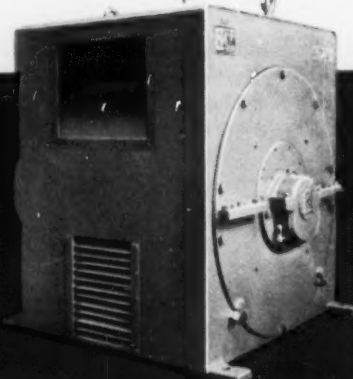
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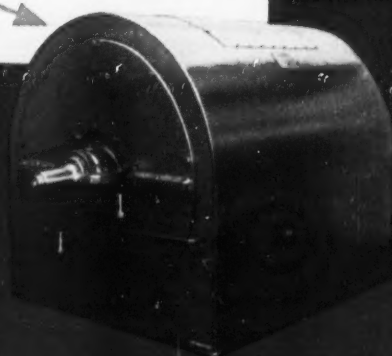
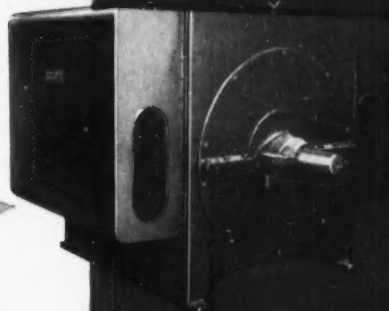
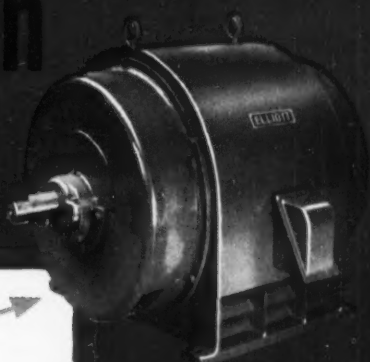
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The Chementator, continued

Sohio, Roy Booth Shannon Oil Co., G&N Oil Co. and Mule Creek Oil Co., will build a plant to dehydrate natural gas.

Sour gas, supplied by the oil companies from the gas processing plant, will go to a large modern sulfur recovery plant that Jefferson Lake Sulphur Co. will build near Manderson, Wyo.

Socony-Vacuum will direct construction and operation of the gas plant at Manderson from its Worland, Wyo., office. The Wendell, Idaho, office of Jefferson Lake Sulphur will supervise all sulfur activities under the direction of Vice President George F. Wilkins. The Ralph M. Parsons Co. of Los Angeles will build both plants. Construction will get under way shortly, and operation is expected in the fall of 1954. Montana-Dakota Utilities Co. will distribute the natural gas from the project.

New way to treat semichemical waste liquor

In a pilot plant at Erie, Pa., that cost more than \$500,000, Hammermill Paper Co. will try out the Zimmerman process for treating semichemical waste liquor.

Hammermill is working with Salvo Chemical Corp. and its parent company, Sterling Drug Co., in the development of the new method, which applies the wet combustion principle of the Zimmerman process to semichemical waste liquor.

After laboratory and small pilot-plant investigations, it was decided to build the larger pilot plant at Erie for testing on a commercial scale. Dravo Corp. of Pittsburgh built the plant. If successful, the method may be used to treat other wastes.

What pollution control costs industry

"It may be conservatively estimated that the annual research expenditure on industrial pollution control in the United States is \$2.2 million or more," Roy F. Weston, sanitary engineer of Atlantic Refining Co. told the AIChE recently in St. Louis. He estimated the research costs of 75 industrial firms to be at least \$750,000 annually. Other industry-sponsored research is being conducted at 57 different scientific institutions. Some 180 research projects costing more than \$500,000 annually are included. In addition, it's estimated that government agencies are spending about \$450,000 a year for this work.

"Industry's investment in waste treatment is of the order of magnitude of \$1 billion," according to Weston, who further points out that 41 of the 48 states have specific water control legislation.

"The American people have spent the equivalent of \$5.3 million (1950 basis) to provide treatment facilities for reducing pollution by municipal sewage. The U.S. Public Health Service estimates that for the next 10 years an additional \$450 million must be spent

annually by municipalities to correct obsolescence, complete backlog construction and meet population increases."

The industrial pollution load is probably greater than the municipal load at present, and will increase at a greater rate. To improve streams despite the ever increasing problem of industrial waste disposal, Weston urges cooperative research by industry. Although the government should be expected to participate in some industrial pollution control research, such work is fundamentally the responsibility of industry.

Such research should supply the knowledge to attain the primary objective of pollution control at the lowest possible cost. Physical research is necessary to attain an understanding of the phenomena of stream pollution and pollution control. And research in the social sciences should be conducted to assure the best possible return in public good will for the money spent on pollution control.

Another ammonia producer for Texas?

Newly organized Chillicothe Chemical Manufacturing Co. plans to build a plant on a 90-acre site near Chillicothe, Tex., to produce 180 tons a day of anhydrous ammonia and 160 tons of prilled urea fertilizer. It will have access to 10 million cubic feet of natural gas per day.

The new plant will cost about \$15.5 million. Chillicothe Chemical, as yet unincorporated, will issue no stock, instead will seek to borrow money. Henry Brandon, organizer of the new company, thinks Chillicothe will be able to get a fast tax writeoff from Washington. A board of directors consisting of about seven persons will own and operate the company.

Foster Wheeler has evaluated the project for Chillicothe Chemical. Construction is supposed to start this spring and will take almost two years. When completed the plant will require about 265 workers for its operation.

Down Under: a new petrochemical era

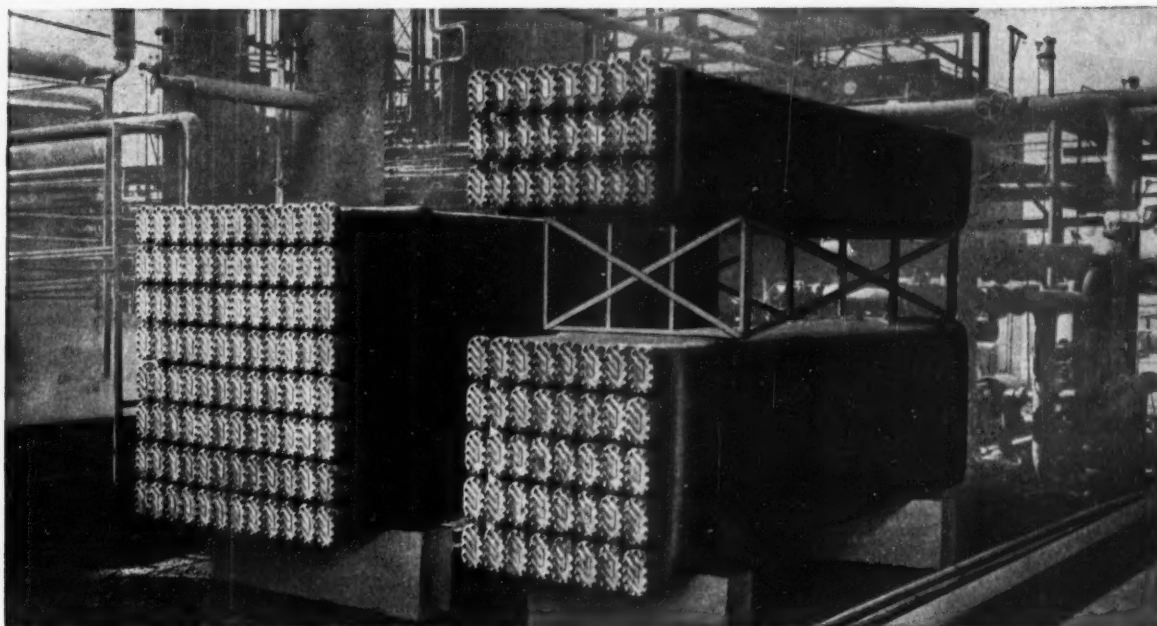
Discovery of commercial quantities of oil in Australia will accentuate plans to build a great petrochemical industry in Australia, and U.S. enterprise is expected to take a big part in this development.

Australia's first petrochemical venture, the newly organized Petroleum & Chemical Corp. (Australia) Ltd. has been set up with initial capital of \$7 million and plans to build a plant at Silverwater near Sydney.

Designs, equipment and technical know-how for this new petrochemical undertaking will be furnished by Gas Machinery Co. of Cleveland, Ohio. It's expected that the plant may start operations late in 1955 or early in 1956. Feedstock will come from Bitumen & Oil Refineries (Australia) Ltd.

Initially, Petroleum & Chemical Corp. will concentrate on production of crude benzene, toluene and
(Continued on page 112)

Six Reasons Why you should specify



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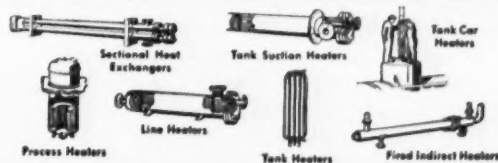
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The Cimentator, continued

xylene. Fuel oil, containing highly aromatic petroleum tars, and residual gas will also be produced. The products to be manufactured will displace previously imported chemicals.

Australia's first producing oil well has recently been brought in by West Australian Petroleum Proprietary Ltd. at a spot 700 mi. north of Perth. West Australian Petroleum is owned 20 percent by Ampol, an Australian outfit, and 80 percent by Caltex, which, in turn, is jointly owned by Texas Co. and Standard Oil of California. Currently, Australia imports about 7 million barrels of crude yearly, mostly from the Middle East and Indonesia.

U.S. investors other than Caltex may back Australia's venture into petrochemicals. In Melbourne, it's thought the decision to start manufacture of petrochemicals will attract foreign companies to join in the scramble. Preliminary surveys and negotiations are already under way, and the Australians expect newcomers to make known their plans within the coming year. Several large U.S. companies are interested. Shell, for example, might become a producer of petrochemicals in the State of Victoria.

Rocket propellants via batch process

Thiokol Chemical Corp. will soon be turning out low-cost solid rocket propellant in a new pilot plant at Elkton, Md., expected to be completed early in 1954.

The pilot plant will be equipped for the integrated processing of up to 40-lb. batches, from raw material pretreatment through motor finishing. Operations will be remotely controlled.

An enlargement of this completely air-conditioned pilot plant is now beyond the blueprint stage. This will make possible production of batches up to 200-lb.

Thiokol is currently producing low-cost solid propellants for the Air Force and industry. The propellants are used in rockets, pressure generators and auxiliary devices.

Prospects for mounting aluminum output

Kaiser Aluminum & Chemical Corp., one of three major aluminum producers in the Pacific Northwest, foresees new uses, improved products and a price cheaper than that of other metals creating an expanding market for aluminum.

Today's production is seven times greater than 1939. And Kaiser engineers think the market for aluminum by 1960 may be two and a half times what it was in 1950, when the U.S. produced 1.4 billion pounds, 44 percent of it in the Pacific Northwest.

By 1960, Kaiser expects the use of aluminum in autos to increase to five times the 1950 level. And even with that growth, Kaiser engineers maintain that the auto industry will be using only one-fifth the aluminum it could use.

As for new uses, Kaiser foresees many possibilities: even the chance that lining for lighter weight winter clothing can eventually be made from aluminum.

Pair of synthetic rubbers to watch

"Two synthetic rubbers which are now in the pilot plant will bear watching," declares Professor Harry L. Fisher of the University of Southern California, new president of the ACS.

"Vulcollan was developed in Germany," Fisher says, "and work on it has already been announced in this country. It has unusually high tensile strength and abrasion and tear resistance, and probably can be used in tires without the use of carbon black and fabric. Hypalon is very different and cheaper, being chlorosulfonated polyethylene, and is being developed in this country."

Simplification, not specialization

"Failure to reduce to the simplest form the ever increasing storehouse of knowledge from which any further improvement in the standard of living and the fuller life must come," prophesies Dr. George E. Holbrook of Du Pont, who received the Professional Progress Award from the AIChE in St. Louis recently, "will result in confusion, dissipation of effort and a slower rate of progress." He also warns that unless new scientific truths are presented in brief, simple and understandable terms, there will be created a morass of confusion, duplication and mediocrity.

Alarmed by the growing complexity in science, business and industry, Holbrook, who is assistant director of development for Du Pont, points out that so far the major effort in dealing with this complexity has been an ever increasing specialization. Holbrook suggests that simplification is a potent but yet untested tool that should be tried.

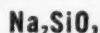
He warns engineers against the use of elaborate and dramatic methods. Instead, he urges the direct use of simple facts and logic in their work. "In deviating from the simple and the direct," he says, "we tend to become slaves of techniques rather than masters of reason."

The engineer should, according to Holbrook, be in an ideal position because of his training and experience to help industrial management by correlating in a simple, clear and concise manner the complex technical and economic aspects of business problems. A disciplined engineer will find many challenging opportunities to aid management by cutting through and eliminating red tape. He must also refrain from creating it.

Another modern pitfall, Holbrook points out, is the excessive and inappropriate use of committees that may be effective as a final court of review but are a poor substitute for individual action in getting things done.

(What's Happening, turn to page 114)

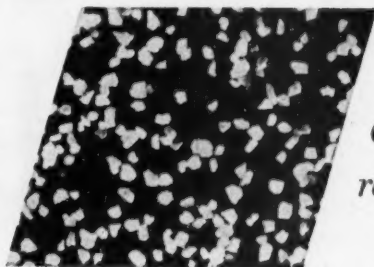
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In the textile industry

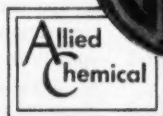


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What's Happening

FEATURE NEWS

Anhydride From Acetone.....	114
Israeli Chemical Expansion.....	118
Refinery Waste Oxidation.....	120
More Polyvinyl Butyral.....	122
Anniversary at Karlsruhe.....	126
Hooker Chlorine Cells.....	128
Flotation Filtration.....	134
French Ethylene Oxide.....	136
Wood Hydrolysis.....	138
Sun's Petrochemical Plant.....	142
Biggest Sulfuric Plant.....	144

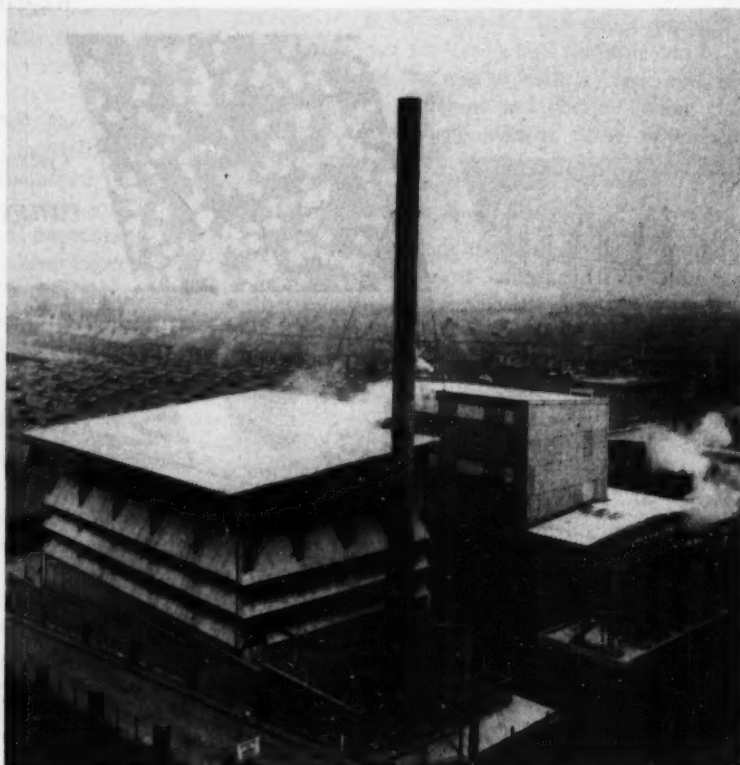
Monsanto Now Turning Out Higher Strength Phosphate

Production of 21 percent feed-grade dicalcium phosphate is now being produced by Monsanto Chemical Co. in its Carondelet plant in St. Louis, Mo., to meet increased demand.

The added capacity will not affect the present production of feed-grade dicalcium phosphate in both the 18 and 21 percent strengths at the Trenton, Mich., plant. Production at both plants will be of low-fluorine content—less than 100 ppm.

Formulators in Iowa, Nebraska, Kansas, Colorado, Oklahoma, Arkansas, Missouri and Illinois will benefit particularly from the combination of this new manufacturing location and recently lowered freight rates. Some formulators in other areas will likewise gain advantages to a lesser degree.

The higher strength 21 percent dicalcium phosphate makes possible a lower cost per unit of phosphorus to the feed formulator. It also results in such features as savings on storage space, greater latitude in formulation, better flow and non-dusting characteristics due to naturally large granulation of the 21 percent product.



COURTAULDS acetic anhydride-from-acetone plant in Coventry, England.

Now—Anhydride from Acetone

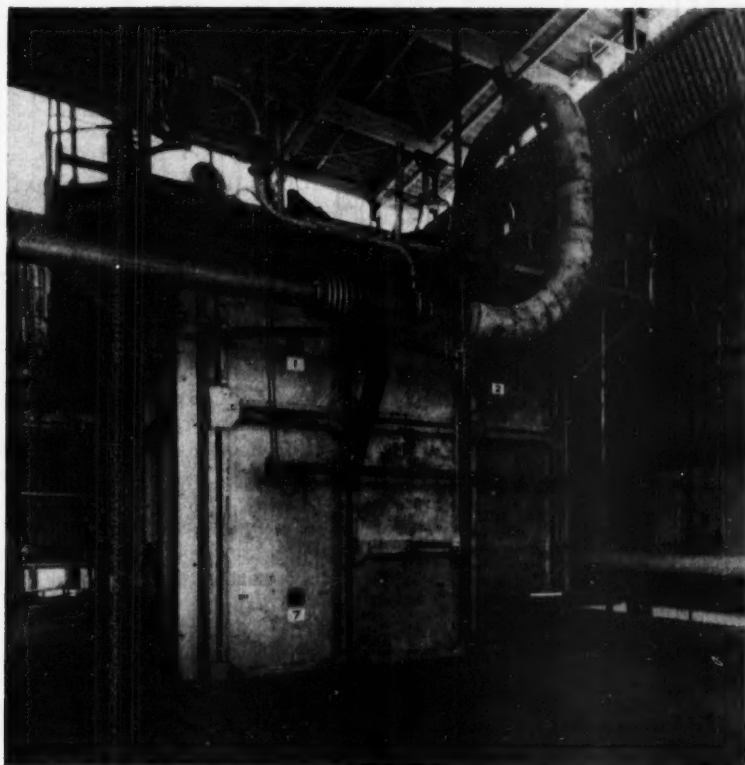
Thermal cracking of acetone goes commercial as a new route to acetic anhydride. Courtaulds uses CS₂ to help control the extent of decomposition in the furnace.

Availability of raw materials has a peculiar way of influencing one's choice of chemical process. Prime example of this situation is the complex economic pattern shown by ethyl alcohol, isopropyl alcohol, acetylene, acetaldehyde, acetone, acetic acid and acetic anhydride.

A new angle to this already involved

picture has recently been added by the commercialization of a process for making acetic anhydride by thermal cracking of acetone. The new plant is operated by Courtaulds Ltd., in connection with its cellulose acetate operations in Britain. Acetone is readily available in Britain from petrochemical isopropyl alcohol.

in Chemical Engineering



CRACKING furnace, specially designed, is the heart of the new process.

► **Competing Schemes**—Looking for a new source of acetic anhydride, Courtaulds' engineers considered the established chemical process routes based on acetylene or ethyl alcohol. Acetylene via calcium carbide suffered from high power and coal costs. Methane cracking to make acetylene wasn't far enough advanced. Molasses-based ethyl alcohol fluctuated too much in price.

Petroleum-based ethyl alcohol looked like a good candidate. But further study showed that another petrochemical, isopropyl alcohol, would probably be a much cheaper starting material. Could acetic anhydride be

made from isopropyl, or its inexpensive derivative, acetone?

Schmidlin and Bergmann in 1910 had described in a German publication a laboratory process for cracking acetone to ketene which, when absorbed in acetic acid, gave acetic anhydride. But the ancient lab data had to be substantiated and the process demonstrated on a pilot-plant scale. Because of the urgency of the project, Courtaulds built its pilot plant in the U.S. by arrangement with a leading oil company.

A gas-fired cracking coil is the heart of the process. The cracked products are rapidly quenched with a recycle

liquor containing acetic anhydride and free acetic acid. This fixes the ketene as quickly as possible after its generation in the furnace.

Unconverted acetone is returned to the process after distillation, and exit gases are scrubbed with acetic acid. The distillation involved is straightforward and was assessed independently in the laboratory.

► **Coking Problem**—So the major pilot-plant objective was to get information for design of a full-scale cracking furnace. The preheating and cracking tubes were made of 25-20 chromium-nickel steel, 1 in. nominal diameter. Copper or silica, previously reported as successful, were ruled out as structural materials for a large plant.

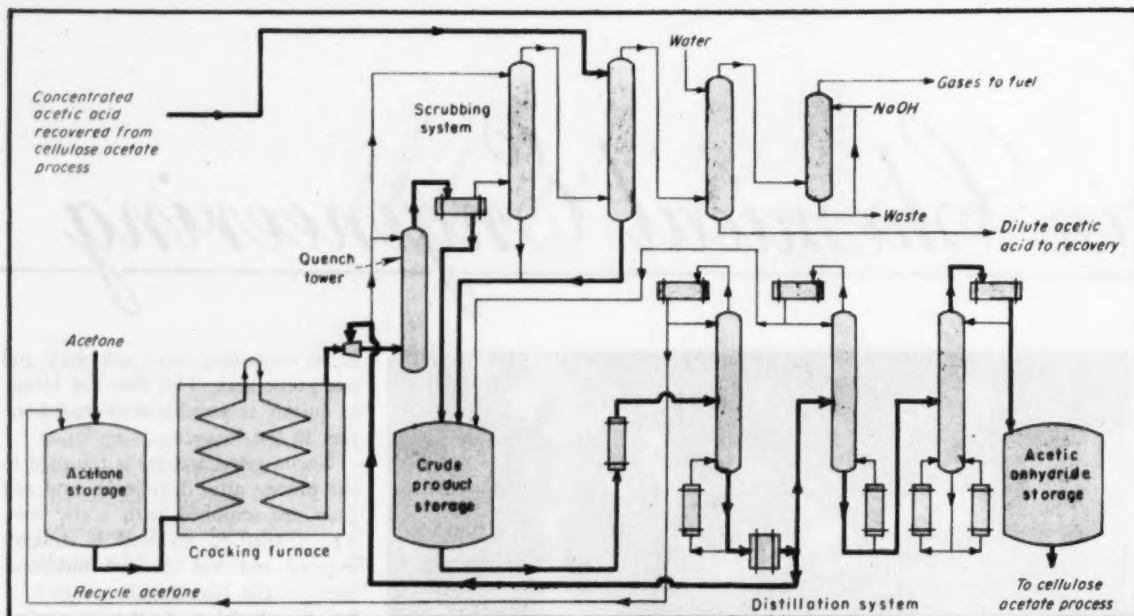
High mass velocities were used to give short contact times and high productivity. The vapor speed also provided sufficient kinetic energy to help scour the tubes free of byproduct coke.

Initially, the coke formation was excessive, and the small tubes blocked quickly. Sometimes they could be cleaned with steam and air. But usually the tubes had to be removed to have the coke bored out mechanically.

New tubes gave almost 100 percent decomposition of acetone into hydrogen and coke. After some time in service they became conditioned so that this undesired dehydrogenating character of the metal surface was gradually reduced. It reappeared, however, after a tube had been purged with steam and air. Such a method of operation would have been too uncertain for a full-scale plant.

► **A Little Bit of CS₂**—Subsequent work by D. L. Tyler (Brit. Pat. 629,211) showed that the addition of very small amounts of carbon disulfide to the acetone feed almost completely inhibited the dehydrogenation reaction.

Three months of pilot-plant opera-



tion sufficed to give basic design data for the commercial plant, including the relationship between selectivity and conversion per pass. It had been feared that minor impurities might build up in the recycle acetone during continued operation. But careful fractionation failed to reveal any important accumulation after continued recycling.

And the conversions were acceptable. Of 100 moles of acetone decomposed per pass, 85.8 were converted to ketene. After figuring losses, this is a yield of 82.2 percent.

► **Full-Scale Design**—Armed with this preliminary information, Courtaulds' chemical engineers designed the plant for a conversion of 25 percent per pass. This gave maximum output. Lower outputs could then be attained, if desired, with enhanced yield. The over-all flowsheet for the process is shown above.

The cracking furnace operates under close temperature control, reasonable heat economy, low pressure drops, and is flexible in its operating conditions. These specifications can be met by many gas-phase cracking furnaces. But acetone has an uncanny ability to find leaks in jointed tubes, and the plant is geared to the needs of a costly manufacturing operation where any interruption of the anhydride supply would be extremely expensive, if not catastrophic. Immedi-

ate replacement of a split or faulty cracking tube is imperative.

A review of available furnace designs did not disclose a standard unit exactly suited to the operation. A new design was made. Essentially the cracking coil is a floating unit, made of solid-drawn and welded tube, about 400 ft. long. Special supports minimize stresses. Should a failure occur, the cover of the furnace is removed and a new coil is substituted. Over-all thermal efficiency is reported to be about 85 percent.

► **Fixing Ketene**—Cracked gases from the furnace outlet are shock-cooled by injection of recycle streams containing an excess of acetic acid. A simple four-jet unit is used for this. An immediate volume expansion takes place because of partial vaporization of the quench feed. To take care of this the pipeline is expanded considerably at this point and thermal strains are absorbed by expansion bellows. A single pass through a packed tower for equilibrium contact and continuous filtration for coke removal follows.

Vapor at about 300 deg. F. leaving the quench tower and containing flue gas, acetone, acetic anhydride and ketene is then condensed. During condensation, ketene and acetic acid combine to form anhydride, with the evolution of heat. The mechanism for this reaction is usually explained by the free-radical theory.

The estimation of condenser surface to deal with this multicomponent gas mixture was a nice exercise in chemical engineering calculation. A trial-and-error stepwise method was evolved for the design, and the answers were checked on a small laboratory unit. Here, as in other parts of the plant, Rosenblad spiral-plate heat exchangers were specified, with stainless steel construction.

The pyrolysis products finally separate into a crude liquid fraction containing the bulk of the acetic anhydride and a gas stream containing a high concentration of acetone and some unabsorbed ketene. Scrubbing and distillation equipment are designed along normal lines.

► **Operating Results**—As the plant has only recently begun to operate, Courtaulds isn't ready yet to discuss long-term operating results. However, after four weeks of coverage by shift chemical engineers, the plant was successfully turned over to routine production.

A remarkable sensitivity of gas make to operating temperature, shown in the pilot plant, has been confirmed in the plant furnaces. The extensive use of automatic control has proved to be a wise investment, since temperatures must usually be held within 1 deg. F.

First reported by W. Gerard Daroux at a meeting of the Soc. of Chem. Ind. and the Inst. of Chem. Eng. (Mar. 1953).

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FERTILIZER facilities at Haifa, hub of Israel's agricultural program.

Israel Expands in Chemicals

Backed up by capital from many nations, the Israelis are beginning relatively vast chemical expansions including the biggest sulfuric plant in the Middle East.

Israel's biggest industry right now is chemicals. When plants now under construction are on stream next year, annual output will be valued at \$15-20 million. And when, in the near future, war reparations are paid by the German government to the Israelis in the form of chemical equipment and machinery valued at \$80 million, even that output will be dwarfed by the expansion that will then take place.

► **Top Chemical Potential**—Israel's potential as a chemical producer is outstanding. Abundant resources in potash, phosphate, manganese, feldspar, Dead Sea chemicals (the Dead Sea is the world's most concentrated reservoir of minerals), give it a very favorable raw materials position. The country has proved resources of 10 million tons of phosphates. Weighing against these advantages, though, the recent Arab-Jewish war and economic difficulties have held the nation back.

But now, with the help of the United States through the Palestine Economic Corp., the English, through Imperial Chemical Industries, the French, South African and other investment trusts, the Israelis are making bold strides.

These are the comments of Ernest Nathan, who has just returned from

a two-month tour of Israel as chairman of the industrial committee of Palestine Economic Corp. Nathan was asked to survey the Israeli potential in chemicals and report his findings to the committee.

Here are some of the highlights of his report.

The country's oldest large-scale chemical venture, Palestine Potash, Ltd., largely destroyed in the Arab-Jewish war, is now back in production, turning out 65,000 tons of potash per year, with the government of Israel talking 300,000 tons by 1956, most of it for export.

A new plastics venture, Sarafon Resinous Chemicals Corp., Ltd., is flourishing and expanding. Having begun operations in 1950, this \$250,000 company, located at Tel Aviv, has been a joint venture of a number of American plastics companies, with the PEC furnishing 20 percent of the capital.

But the country's major efforts are concentrated in Fertilizers and Chemicals, Ltd., Haifa, the largest chemical operator in Israel.

► **World Wide Backing**—This company produces sulfuric acid, oleum and superphosphates in its Haifa plants and will soon turn out fixed nitrogen as part of its present expansion program. The company began

operations in September, 1949, as a result of the efforts of Palestine Potash, Ltd., and PEC which brought in the Rothschild Foundation, African Palestine Investment Co., South African Enterprises and Hamashbir Hamerkazi Co., Ltd., as backers.

In 1951, the company ordered more than \$5 million worth of new equipment, principally from the U. S. and France; and Chemical Construction Corp. was retained to do the engineering and construction. Right now, the construction program is at its peak. All of the financing has been completed with the exception of \$2 million, and negotiations are under way in the U. S. right now to raise that amount. When the program is completed in 1954, \$14 million in all will have been invested in Fertilizers & Chemicals, Ltd.

Here's a listing of the F&C expansion projects:

► **Sulfuric Acid Plant**—Rated capacity 230 tons per day from pyrites. Now in operation. Israel has arranged a barter deal whereby Turkey will exchange pyrites for part of the sulfuric acid produced. The previous acid plant, a 30-ton-per-day unit, will continue in operation.

► **Phosphoric Acid**—Plant under construction. Capacity 30 tons per day P_2O_5 . Will be finished April 1, 1954.

► **Superphosphate**—Normal strength: The existing Kühlmann plant has a capacity of 70,000-75,000 tons per year and can run at that capacity without changes. Concentrated superphosphate: Rock phosphate and phosphoric acid. Can operate as soon as phosphoric acid is available.

► **Dicalcium Phosphate**—Capacity 25 tons per day. Cost, about \$250,000. Date of completion: March 1, 1954.

► **Potassium Sulphate**—Capacity 1,000 tons per month. Uses 25 tons H_2SO_4 per day. Schedule: Feb. 1, 1954.

► **Ammonia plant**—Completion estimated for Sept. 1, 1954. Rated capacity 42 tons per day at present because of a gas shortage. Can produce 75 tons per day to put the plant within the sphere of economic operation as soon as enough gas is available from Consolidated Refinery at Haifa (oil pipelines are closed because of an Arab boycott). Total storage: 140 tons. The ammonia plant is built so that without major conversion changes it could be put alternatively to manufacture methanol.



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WHAT'S HAPPENING . . .

► **Nitric Acid**—Plant ordered. Completion: Sept. 1, 1954. Capacity: 40 tons per day. Uses 12.5 tons ammonia per day; used all for either ammonium nitrate or ammonium sulfate. Increase of capacity to 60 tons per day being investigated. Some parts of unit large enough. Figures on cost of increase being investigated.

► **Ammonium Nitrates** — Will order either ammonium nitrate or ammonium sulfate units to use 10,000 tons of ammonia per year. To be finished Sept. 1, 1954.

► **Ammonium Sulfate**—Will be finished in time for the completion of the ammonia plant, Sept. 1, 1954. Capacity: 100 tons per day. Direct neutralization of ammonia and sulfuric acid.

In addition, a formaldehyde unit has been recommended for construction. It would cost \$150,000 and produce 7 million pounds a year. Also, a urea unit has been suggested to make urea out of ammonia and CO₂ by a new process. Cost would be about half a million dollars.

All in all, it looks like Israel's agricultural program will be well supported by chemicals by 1955 when all of the above units are expected to be on stream.

CONVENTION CALENDAR

Association of American Soap & Glycerine Producers, annual meeting, Waldorf-Astoria Hotel, New York, January 26-28.

Chlorine Institute, Inc., annual meeting, Biltmore Hotel, New York, January 27.

Chemical Institute of Canada, protective coatings conference, Toronto and Montreal, February 25-26.

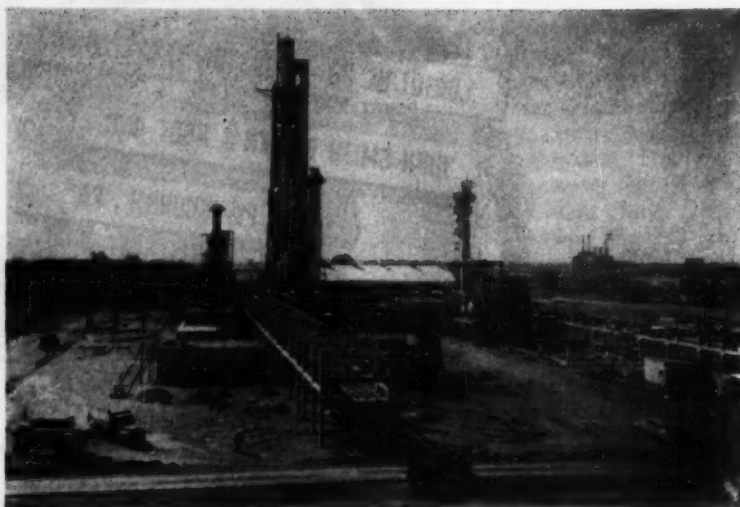
Drug, Chemical & Allied Trades Section, New York Board of Trade, annual dinner, Waldorf-Astoria Hotel, New York, March 4.

American Institute of Chemical Engineers, national meeting, Statler Hotel, Washington, D. C., March 8-10.

Commercial Chemical Development Association, annual open meeting, Statler Hotel, New York, March 17-18.

Industrial Research Institute, award dinner, San Francisco, April 22.

Association of Consulting Chemists & Chemical Engineers, symposium and banquet, Belmont Plaza Hotel, New York, April 27.



Refinery Oxidizes Wastes

First refinery in the world to use bacterial oxidation to combat pollution by purifying waste water is the Sarnia, Ontario, refinery of Sun Oil Co. Ltd.

This is the first time that any refinery has installed a commercial bacterial oxidation process to remove phenol or other organic wastes, according to Gordon R. Henderson, refinery manager.

The installation comprises three systems for the preliminary separation and treatment of different types of waste water from the refinery. Sarnia's waste treating plant may become a model for future refineries. The American Petroleum Institute has adopted the installation as a standard for the refining industry.

This initial segregation of waste water streams is necessary for the economical installation of the bacterial oxidation process. Without such preliminary segregation, such a process would require a lengthy installation period and consequently greater expense.

In the new process, waste water from a separator that removes any free oil present is mixed with a stream of purified water. The diluted waste water is then pumped to a large oxidation pit, 90 ft. long, 70 ft. wide and 12 ft. deep.

This stream enters from the bottom of the pit through a network of 40 ejector jets that aerate the water and eject it in a fine spray.


These ejectors perform two important functions. They keep the water circulating in the oxidation pit with an activated sludge containing millions of bacteria. Also, they add the necessary oxygen to the water to sustain the bacteria, which consume the phenol or other organic waste in the water, transforming it by decomposition to harmless organic material.

After circulating in the oxidation pit for six to eight hours, the treated water is drawn off through an overflow line at the top of the 10-ft. water level. It then flows to another separator that collects the bacterial sludge present for clarification of the effluent.

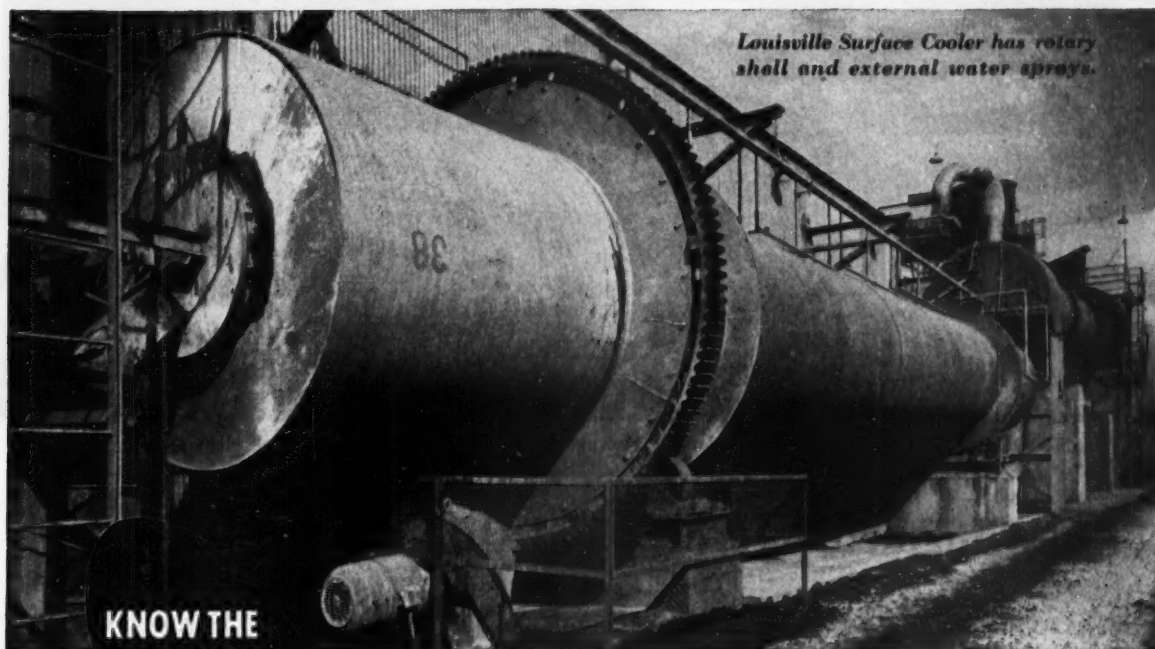
The bacterial sludge is drawn off and pumped back to the oxidation pit, ready to go to work again in removing phenol or other organic waste from the water.

Although Sun is the first petroleum refinery to install this process, it has been operated successfully by other industries and by large cities. Also, three U. S. oil companies reportedly have been operating experimental plants, and another refinery is making a commercial installation.

Sun has disclosed all available technical information on the purification process to the International Joint Commission on Water Pollution. Engineers of the Joint Commission are interested in the Sun installation as a possible solution to the prevention of pollution of boundary waters between the U. S. and Canada.



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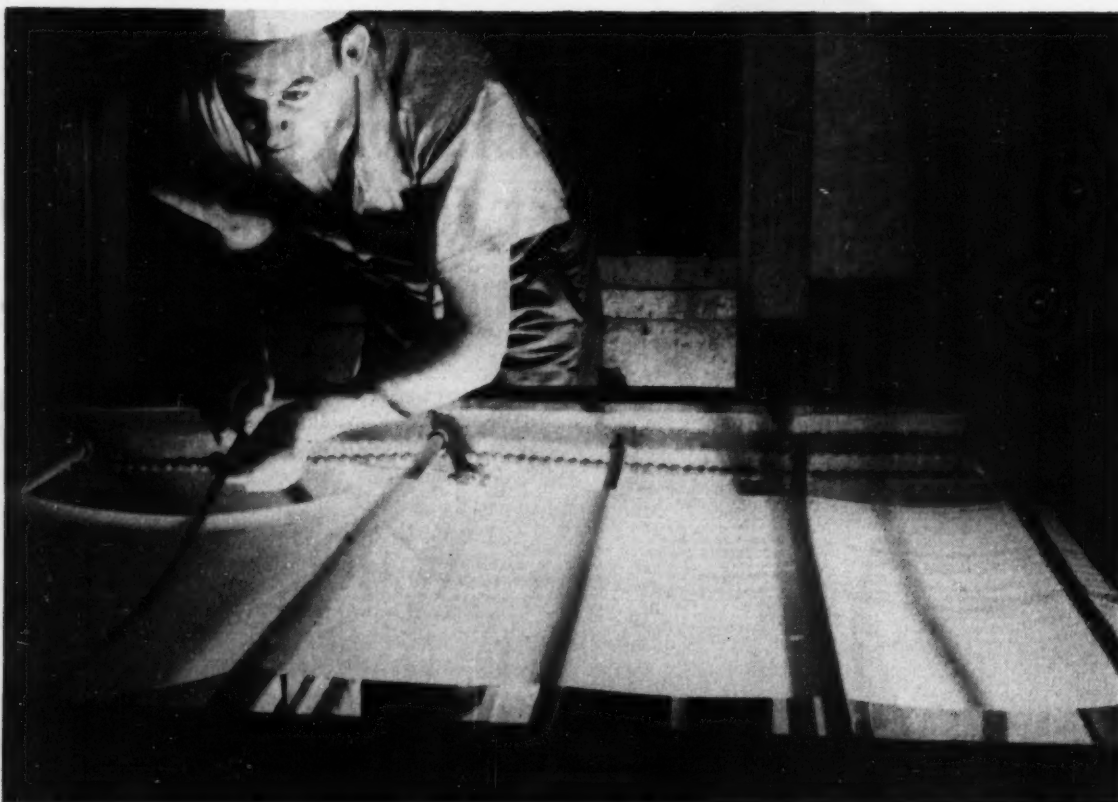
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Shawinigan Ups Polyvinyl Butyral Capacity

Shawinigan Resins Corp. is giving one boost after another to its production of polyvinyl butyral—the stuff that puts the safety in safety glass.

They certainly don't grow pessimists in Springfield, Mass. Despite warnings of a production cutback in the automobile industry, principal consumer of polyvinyl butyral, and a general industry-wide slowing-down in construction activity, Springfield's Shawinigan Resins Corp. recently completed one expansion of its butyral facilities and is now in the midst of another. This latest marks the fifth in the 10-yr. history of Shawinigan, a jointly owned and operated subsidiary of Shawinigan Products Corp. and Monsanto Chemical Co.

Hardly had the paint dried on the units installed last year, which upped capacity some 35 percent, when this April was set as the completion date for another expansion—this one to add

an estimated 20 percent to the capacity.

► **Here's Why**—Shawinigan points out that its expanded capacity will meet the anticipated market demand for at least three more years. In reaching its decision to expand now, Shawinigan looked beyond today's watchful-waiting attitude in business to the prospect of increased requirements for the resin in the future.

As R. K. Mueller, Shawinigan president, puts it: "The decision to go ahead, to expand—even though the market will not absorb the capacity immediately—is a distinct change from the situation of recent years when the industry has had its hands full expanding production facilities just to keep pace with growth."

► **Where It Goes**—The characteristics of polyvinyl butyral film—resistance to heat, light and moisture over a wide range of conditions, toughness, pliability, and transparency—fit it ideally for its prime role as the interlayer in safety glass. As such the automobile industry ranks as the biggest customer by far.

However, with automobile production expected to drop from 1953's record high of over 6 million units to some 5,200,000 units this year, other outlets are combining to take up some of the slack. Shatterproof picture tubes for television sets is one newly opened market expected to glow brighter in the future. Butyral film is also being used in military aircraft as interlayer in laminated plastic

For a pictured flowsheet of Shawinigan Resin's polyvinyl butyral process see pages 346-349.

A major oil refining company on the eastern seaboard is building a catalytic reforming plant with capacity of 17,600 barrels per day....

... and PETROCHEM-ISOFLOW Furnaces will charge this 17,600 bpd plant.

A major oil refining company on the Texas gulf coast is building a catalytic reforming plant with capacity of 21,000 barrels per day....

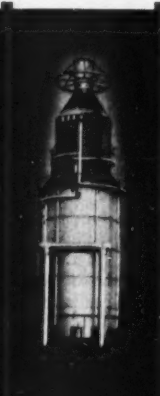
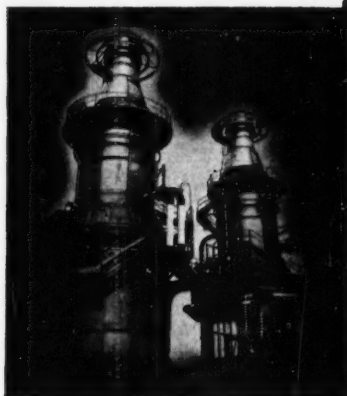
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SAFETY GLASS cracks, but interlayer holds pieces in place. ORDINARY GLASS results in a shower of glass slivers.

housings to prevent the shattering of the structure due to spreading of the cracks around bullet holes.

Molding compounds, coatings, adhesives and paint primers account for another chunk of the resin market. And more and more outlets are being developed.

The total demand for polyvinyl butyral now runs between 15 and 18 million lb./yr. It is being met by three firms: Shawinigan, Du Pont and Carbide and Carbon. Currently, Shawinigan has the biggest slice of the market.

► **How Its Made**—In the Shawinigan operation, raw material comes from one of the parent companies and finished resin is sent to the other.

Vinyl acetate monomer, most of it from Shawinigan Products, is the starting point of the process. It is polymerized, dissolved in ethyl alcohol and hydrolyzed to polyvinyl alcohol. The PVA reacts with butyraldehyde to form the polyvinyl butyral. The resin—tagged Butvar by Shawinigan—is precipitated from the alcohol solution, washed, centrifuged and dried in a rotary warm-air dryer.

Dried resin is air-conveyed to a sifter and packed for shipment. A big part of the output goes down the street to Monsanto's Plastic Division for extrusion into sheets for interlayer

Accidental Discovery Of Safety Glass

Safety glass is one of those accidentally discovered commodities—like Goodyear's vulcanized rubber, Nobel's blasting gelatine and Brearley's stainless steel—which turn up when investigators follow an accident or chance observation with imaginative experimental work.

In 1903, a young chemist, Edouard Benedictus, was cleaning his laboratory. As he picked up a flask it slipped from his hands and fell to the floor. Yet the flask was not completely smashed. From the label he saw that it had contained a solution of celluloid in acetone; the acetone had evaporated, coating the inner surface with a celluloid film.

As it appears in his note book: "I picked the flask up and saw that it was indeed cracked in a radial pattern, but all the parts were held together as by an inner force." He might have left it at that but for two accidents soon after in which a number of people were cut by flying glass. He returned to his lab and on the following evening held the first piece of safety glass in his hands.

use. Monsanto mixes the resin with plastizer to form a dough-like material. This is extruded under high pressure and temperature into sheets, ribbed for easy handling.

The soaring demand for the interlayer has caused Monsanto to increase its facilities recently, too.

Shawinigan is able to modify the

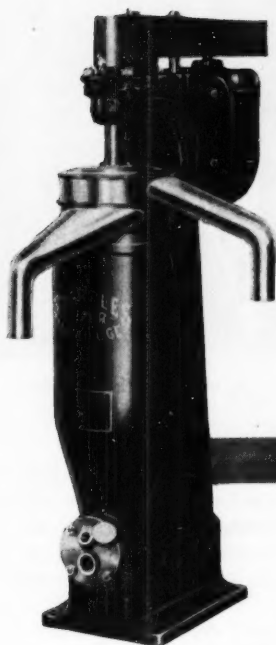
resin by varying the conditions at which the various reactions—polymerization, hydrolysis and acetalization with butyraldehyde—occur. Thus the product may be "tailored" to a particular end use.

► **Equipment**—Much of the process equipment is glass-lined and nearly all of the recent additions to the production line have been installed outdoors.

Those vessels requiring close supervision are roofed over. However, extensive instrumentation has kept the need for roofing to a minimum.

Use of large quantities of flammable solvents in the process introduces serious safety problems. To prevent vapor accumulation a high degree of local ventilation is provided. At the same time, the various reaction and storage vessels are grounded to reduce the possibility of static discharge, and all equipment is inspected frequently to detect mechanical defects which may cause sparking or local overheating.

► **Control**—Since much of the process consists of batch operations, sampling and testing has always been quite extensive—and expensive. Use of the techniques of statistical quality control—though primarily to insure product uniformity—has resulted in improved test procedures and reduced control costs.



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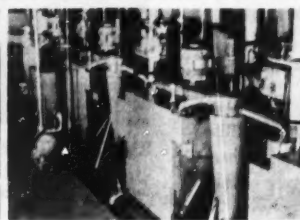
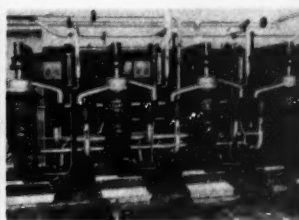
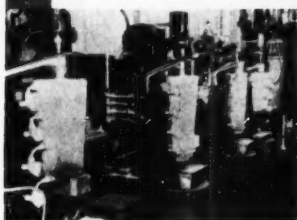
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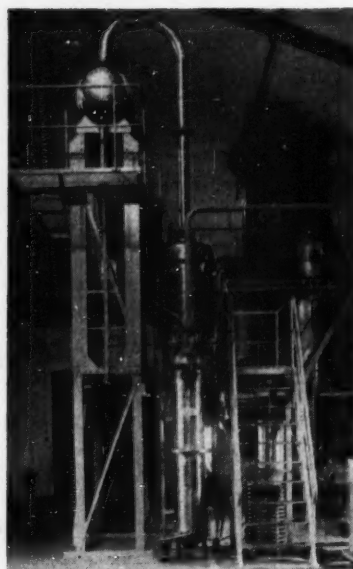
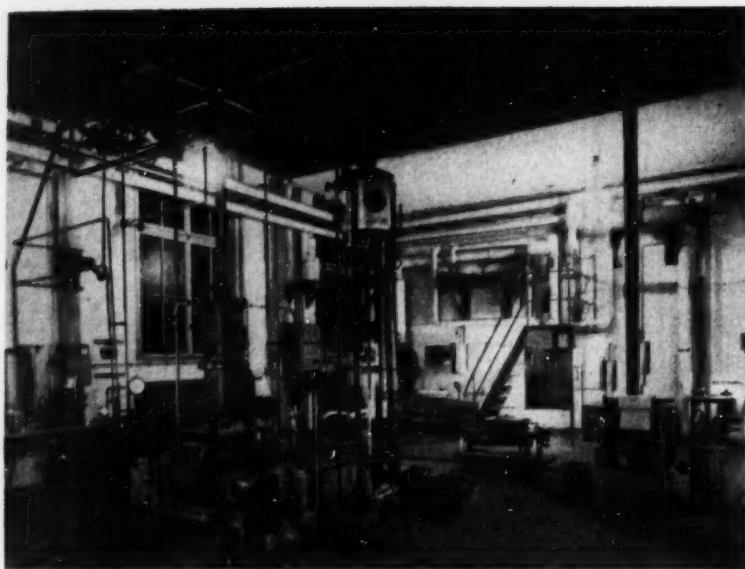
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IN WEST GERMANY, the department of chemical engineering at Karlsruhe is world-famous for its unit operations studies.

A 25th Anniversary

Karlsruhe, oldest of German polytechnic schools has just passed a milestone. Its department of chemical engineering, only one of its kind is 25 years old.

It was 27 years ago that R. Plank returned to Germany from the United States. He then urged that an advanced and specialized training in chemical engineering be provided in Germany. He was actively supported by Immo Glenck, then chairman of the Council of Process Equipment Builders.

So 25 years ago Karlsruhe inaugurated its Department of Chemical Engineering by offering graduate courses in the subjects of processing techniques and equipment design.

Karlsruhe, the oldest German polytechnic schools, was selected as it already offered curricula in mechanical engineering and industrial chemistry. It was here that Engler had investigated the properties of oils, Haber had originated his ammonia synthesis, Bunte established his gas institute, and Plank did research in refrigeration and deep freeze food preservation.

While Profs. Askenasy and Plank provided the necessary space, industry supplied the equipment. The Association of Applied Chemical Engineering, founded in 1926 by Max Buchner, and now under the presidency of Herbert Bretschneider, together with the

German Society of Engineers, also augmented the facilities of the new department.

In 1937 the government granted funds for a new laboratory organized on the basis of the unit operations concept. It was again equipped with the necessary apparatus by industry and scientific associations. Damage



EMIL KIRSCHBAUM, present head of the chemical engineering department at Karlsruhe, an international authority on distillation processes.

sustained during the war years was heavy but could largely be overcome by coordinated efforts from all sides.

The main laboratory now occupies one and a half floors of approximately 50 by 75 ft. area. In addition there are spaces devoted to physical chemistry and chemistry work, a weighing room, three offices for assistants, a machine shop and storage spaces.

Training for undergraduates is identical with that for mechanical engineering students. The next two years are devoted to thermodynamics, physical chemistry, unit operations and processes, process equipment design and plant engineering.

While the first duty of the department is to provide effective teaching service, it is assuming an increasing importance as an international research center. Its findings have been published in books and technical articles bearing the names of the present head, Dr. Emil Kirschbaum, and his associates. Grouped according to their relative importance, the topics include: (1) Heat exchange, evaporation, condensation; (2) industrial distillation; (3) drying, especially spray drying; (4) comminution processes; (5) filtration; (6) design details and materials of construction.

Since its inception, 25 years ago, about 300 men have graduated from the department, or an average of 12 a year. Hence there is no oversupply of chemical engineers in Germany.

How to make metal float



THERE is nothing new about the practice of moving solids, at low cost, by slurring them in a liquid and pumping them through a pipe.

This operation was given a new twist one day, when a company told us they wanted to slurry *metallic copper* particles in water, and move 30,000 pounds of copper per hour through a 1,000-foot pipeline to another department.

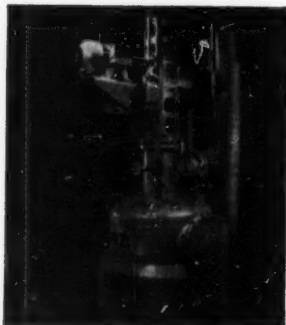
At first, it looked like an impossible suspension job to the Mixco engineer handling this request. When he turned over the sample jar containing 35% by weight of copper particles in water, the copper settled so fast he could almost hear the "thud" as it hit bottom. However, he took the sample into the laboratory for examination and tests.

There it was discovered that the copper had a slightly porous structure. In a large test tank, calibrated impellers worked on the heavy mass. An optimum was reached when a large turbine impeller, turning at slow speed, produced the *high level of flow* needed to lift and maintain the solids in suspension, at an input of only seven horsepower per thousand gallons of slurry.

Previous tests by the customer showed this suspension, properly mixed, could be pumped the necessary 1,000 feet at high velocity, emerging at the filters as a uniform slurry.

A standard-design LIGHTNIN Mixer, with slight modification to meet the customer's special needs, was specified to transmit the required power with 97% efficiency.

In service three years, the mixer has performed this exacting job satisfactorily.



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Assembly-Line Methods Cut Chlorine Cell Costs

Design of Hooker cells facilitates mass production of the several components for ready assembly in the cell room.

During 1954 the number of Hooker Type S-3 and S-3A electrolytic cells in caustic-chlorine service in the U. S. will reach a total greater than 1,500.

Such popularity must be deserved. In part it is due to the careful mechanical design of the cells. Here Hooker Electrochemical Co. has achieved two desirable results—the cells can be fabricated on a mass-production basis, keeping first costs low, and they are easy to service and renew, keeping maintenance costs likewise at a minimum.

The accompanying photographs show how Hooker, with the help of a local metal fabricator, turns out Type S-3A cells on a virtual assembly line. The metal fabricator makes the cathodes. Hooker does the rest in its Niagara Falls plant—casts the concrete tops and bottoms, makes the anode assemblies, deposits the diaphragms and assembles the complete cells.

The large number of cells which Hooker makes justifies a sizable investment in molds, jigs and other production tools. Especially useful is the jig which helps in making the anode assembly shown in Fig. 7. Graphite anode blades and two copper bars are placed in the jig and then cast into a lead base, which acts both as the current conductor and the means of holding the graphite in the proper array to go into the spaces between the cathode fingers.



I POURING a concrete cell top. Automatic scales meter ingredients to the mixer to insure uniform quality.

Why *is "Lead" used* to control *Sulphuric Acid Corrosion?*

For centuries "Vitriol" was hard to harness.

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Lead should come first to mind in the control of corrosives because:

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- 2 Lead cooperates when it is fabricated.** No common metal is easier to work. Even in the field you can easily melt and cast it . . . mold and shape it . . . cut or form it. You can "burn" (weld) lead to lead with simple equipment. You can bond it to steel or copper.
- 3 Lead is economical and available.** Its cost per pound is low. It costs little to maintain. When its application has run its course, lead has high salvage value . . . often a substantial percentage of original metal cost.

b
WHAT GOES
FOR LEAD
AND H_2SO_4 ,
GOES FOR
LEAD AND
HUNDREDS OF
OTHER
CORROSIVES

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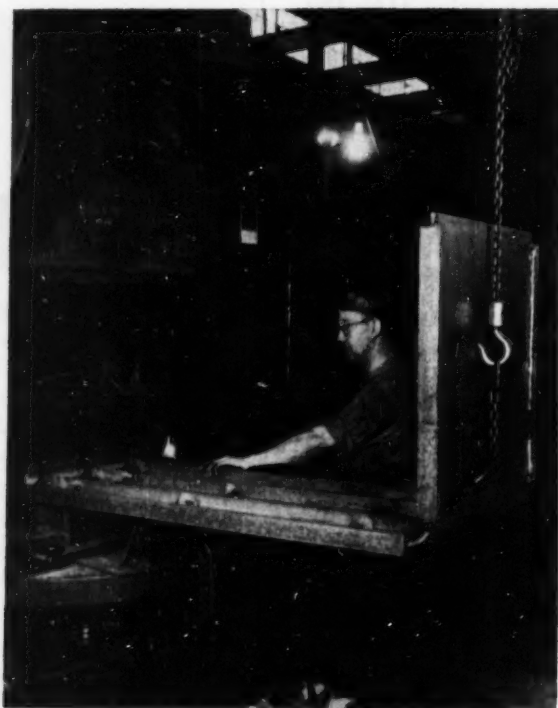
Concrete tops and bottoms, steel sides form basic structure



2 FINISHING and numbering a concrete cell top. The concrete has set enough to strip the outside form.



3 CURING the concrete cell tops and bottoms. They are cured under warm water to obtain maximum strength.



4 FORMING the cathode frame. Flanges have been welded to steel plate, which is bent in a hydraulic press.



5 ATTACHING copper conductor to cathode. This welding job requires special techniques and high currents.



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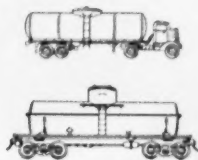
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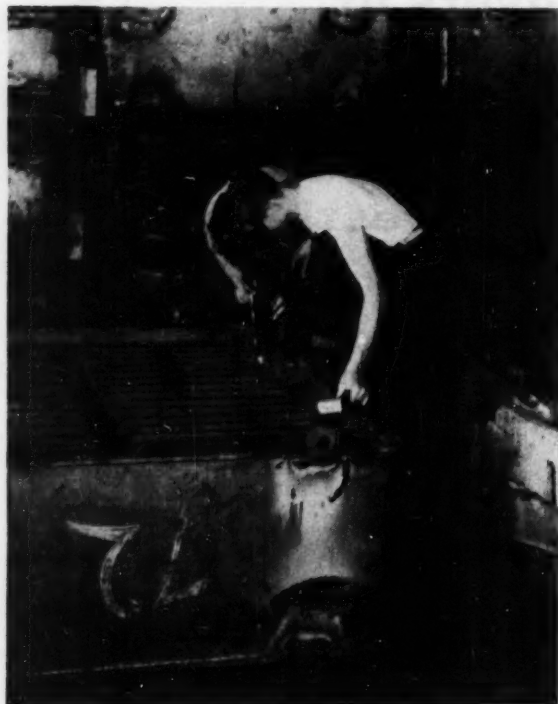
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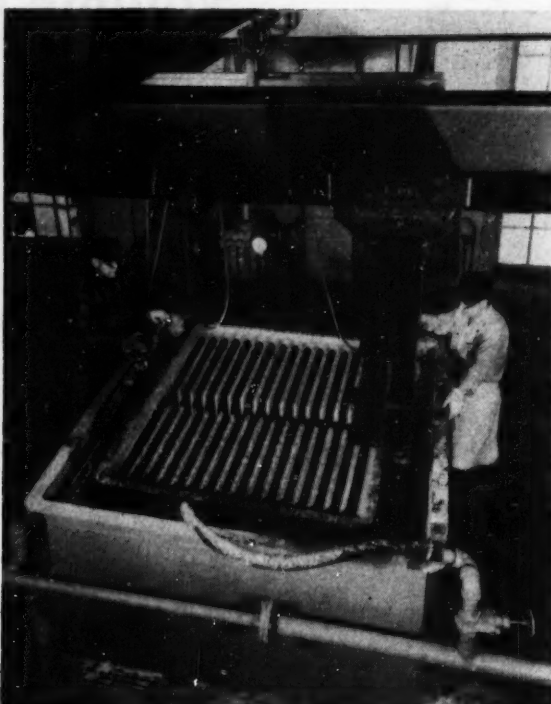
Detergent Slurry • Detergent D-40 • Detergent D-60
Dispersant NI-W • Dispersant NI-O • Wetting Agents



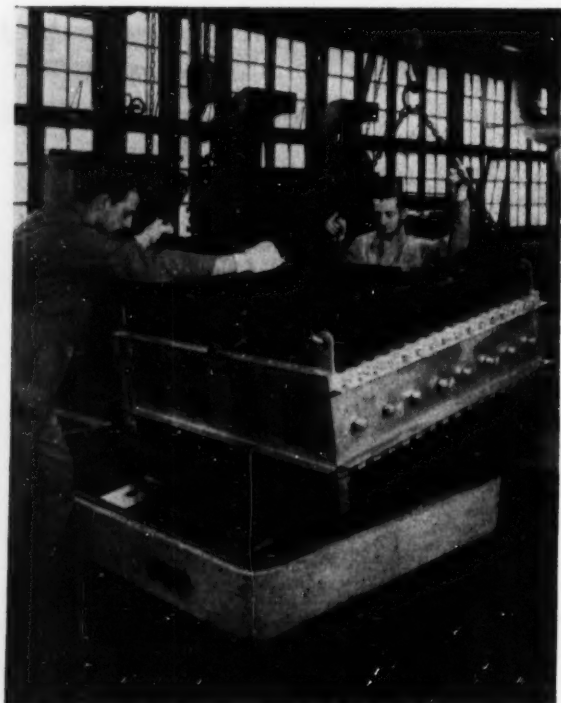
Cathodes, anodes and diaphragm complete the S-3A cell



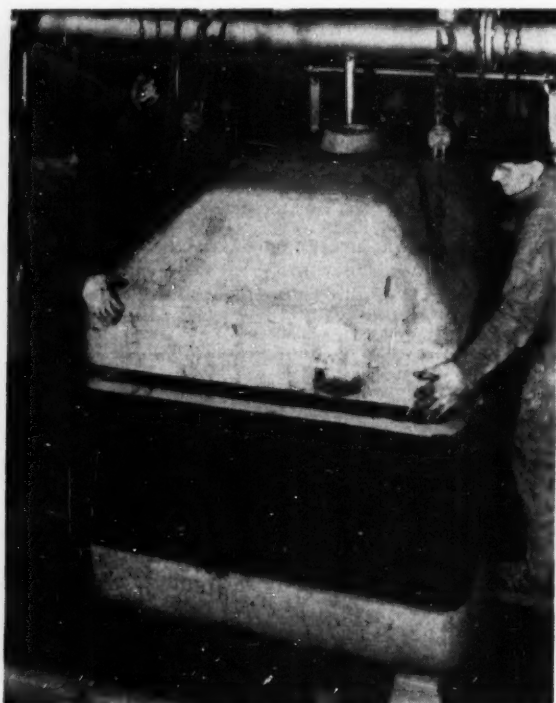
6 WELDING cathode fingers to frame. The large cathode area gives high capacity per unit of floor space.



7 DEPOSITING the asbestos diaphragm. Vacuum pulls slurry onto steel screens, forming asbestos layer.



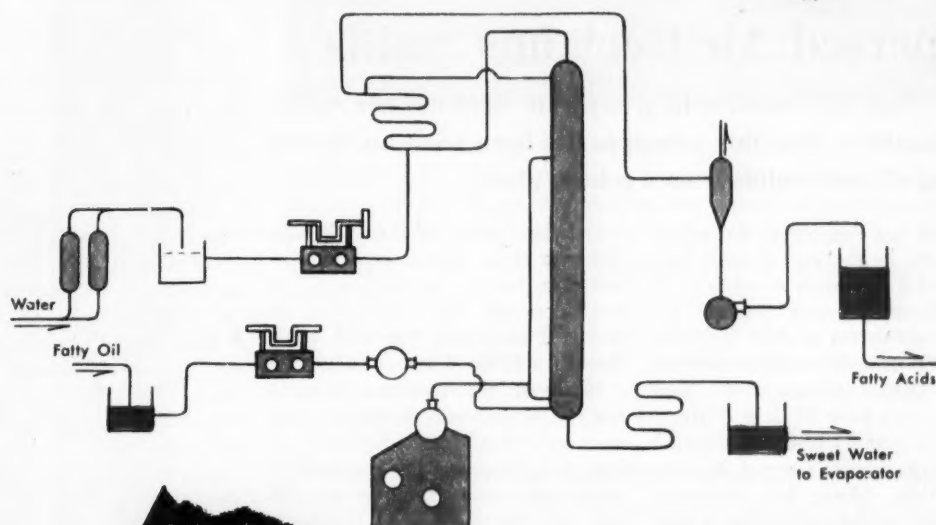
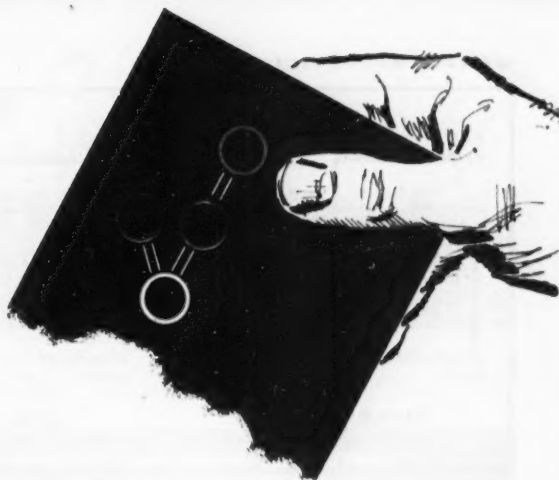
8 ASSEMBLING graphite anodes and concrete cell bottom. The assembly is made by casting in a lead base.



9 FINAL ASSEMBLY in the cell room. The three major parts—anode, cathode and top—meet at last.

Up to 98% split without a catalyst!

... with continuous fat-splitting
plant built by Foster Wheeler



TO the plant whose cycle can conform to a continuous fat-splitting operation, the Colgate-Emery process offers high splitting efficiency *without a catalyst*. With a small amount of catalyst, the percentage of split becomes still higher.

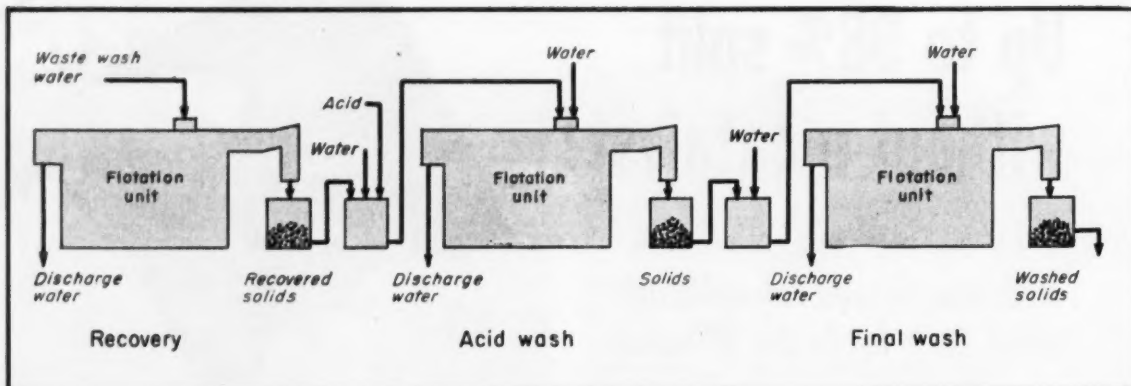
Designed and constructed by Foster Wheeler to meet the individual needs of the manufacturer, such a plant possesses unusual versatility—both in fatty acids made and charging stock used.

Color is exceptionally light. With high grade feed stocks, neither acid boil nor distillation is needed. Still other advantages are given below. Facts and figures on request.

SAVINGS AT A GLANCE

Increased plant capacity	Lower splitting costs
Higher throughput	Low steam and power consumption
Uniformity of product	Low labor costs
High economy: About 5 lb. fat split per 1 lb. steam	Small space requirements
Ease of control and operation	13 to 18% glycerine concentration in sweet water

FOSTER WHEELER CORPORATION, 165 BROADWAY, NEW YORK 6, N. Y.



Dispersed Air Reclaims Solids

Tiny air bubbles help separate hard-to-filter solids from liquids. Now this principle has been tried on repulp washing of waste solids from a gelatin plant.

Interest has burgeoned, during recent years, in the use of air-bubble flotation for separation of solids from large volumes of water. Principal industrial application to date has been in removal of waste solids from plant effluent waters (*Chem. Eng.*, April 1951, p. 107; June 1952, p. 270).

Now a manufacturer of flotation units, F. S. Gibbs, Inc., of Newton Lower Falls, Mass., has conducted plant trials on the conversion of such waste into a useable product. Solids that normally would be discarded because they couldn't be handled can be upgraded to increase total process yield.

► **No Flotation Agents**—Unique feature of this development is the ability to wet-process non-filterable solids and still separate them effectively from the water. It's done, too, without the use of chemical flotation agents; bubbles are formed by induction of atmospheric air through a porous ceramic element into the suction of a centrifugal pump.

Initial trials of this idea have been carried out on waste wash water discharged during manufacture of gelatin at a large New England plant. In the production of some grades of gelatin, hides and bones are soaked in lime for a number of weeks. Following the lime soak the material is washed in running water for several hours under constant agitation.

During the washing step an appreciable quantity of collagen is abraided

away by the action of the wash rolls. Although these protein particles normally are lost in the wash water, it was discovered that they could be recovered by passing the wash water through a Gibbs flotation unit.

However, the recovered material had to be washed alternately with acid and clear water. Attempts to carry out these steps by conventional means were unsuccessful. Screens, filters and centrifuges were unable to separate the gelatinous particles from the wash waters.

A satisfactory answer was found in the use of flotation separation on the washing steps following initial separation. Final washed product was suitable for transfer directly to the gelatin extraction kettles.

► **Tank Separator**—The flotation unit used for this operation is a rectangular open-top vessel. Solids-laden water enters through a pipe at the bottom of one end. A baffle directs flow upward and along the tank to the opposite end. Here flow changes direction toward the tank bottom and a slotted discharge outlet. Once through this discharge outlet the water rises for final discharge over a weir at the level of the tank surface.

At the discharge end there is a pipe leading from the flotation tank to the inlet of a centrifugal circulating pump. A porous diffuser cylinder connected to atmosphere is mounted in this pipe. Line suction aspirates air into the water in the form of minute bubbles.

Pump discharge enters the flotation vessel in two different zones. Part of the flow is directed into the feed inlet pipe. The remainder enters the vessel through nozzles in the zone between the feed-end baffle and the discharge end.

Bubbles in the circulating water attach to the entering solids and float them to the surface. Scraper blades on an endless chain continuously remove the floated material.

► **Three Steps Needed**—A collagen recovery system requires three flotation steps. During the plant trials all three steps were handled in succession by the same unit.

Waste wash water enters the first step, carrying 100 ppm. of fine solids. Flow rate is in the range of 3 to 4 gpm. per sq. ft. of flotation area. Recovery efficiency ranges upward from 80 percent; efficiency increases as lime loading decreases.

Sludge discharged from the first step at a consistency of 3.5 percent solids is repulped with acid and dilution water to a concentration of 50 ppm. This high rate of dilution for collagen is needed to obtain the desired degree of washing. Normally, good separation is claimed on similar materials with loadings of 4,000 ppm.

Separating efficiency on the acid washing is essentially 100 percent. Sludge discharges at 6 percent solids.

Acid-washed solids are repulped in water to a concentration of 50 ppm. and passed through a third flotation step. No solids are detectable in the effluent from this stage. Sludge leaves the vessel at 5 percent solids and goes to gelatin extraction kettles.

Over-all plant yield of gelatin is increased by 1.35 to 1.75 percent. This spread in yield-increase is due to variations in the raw material.

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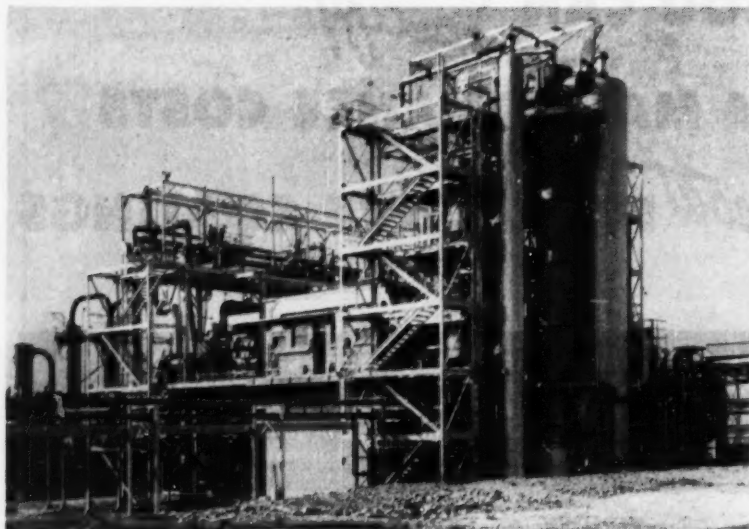
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Yields More Ethylene Oxide

New French plant begins commercial production of ethylene oxide by direct oxidation. Process shows higher yield, lower investment, than previously published data.

Direct oxidation of ethylene to ethylene oxide has become a commercial reality for the first time in Europe. Just six months ago Naphtachimie, at Lavera, France, began operation of its new plant, part of an integrated \$20-million petrochemical project designed to make isopropyl alcohol, acetone, ethylene glycol, ethanalamines, glycol ethers, polyglycols and other products.

The process used by Naphtachimie is one developed over the past seven years by Scientific Design Co., New York, with the collaboration, in its earlier phases, of Petrocarbon Ltd. and Petrochemicals Ltd. in England.

Right now the only other commercial producer of ethylene oxide by direct oxidation is Carbide and Carbon. However, Carbide and Naphtachimie will soon be joined by Allied Chemical and Dye, whose Orange (Tex.) oxide-glycol plant, designed by Scientific Design and using the SD process, was expected to start up early this year.

► **Higher Yields**—The Naphtachimie plant shows consistently high yields of oxide—percentages in the sixties, based on ethylene. These higher yields are obtained with satisfactory throughput

rates; Scientific claims that capital investment per unit of capacity is lower than previously published figures. On the other hand, published pilot-plant data for various other direct oxidation processes show yields of only 55 to 57 percent as the economic optimum.

The product is also of high purity, meeting all commercial requirements. It analyzes 99.5 percent oxide. In regard to aldehyde and chlorine impurities, it is said to be far superior to that produced by the older chlorohydrin process.

The plant was designed for a capacity of 17 to 20 million lb. per year, but initial operation has already shown that this capacity can be exceeded by a substantial amount if desired.

► **Process Competition**—Naphtachimie originally had planned to make its ethylene oxide in a conventional chlorohydrin unit. The direct oxidation process was substituted because of much lower operating costs, estimated at 25 percent less than chlorohydrin.

The chlorohydrin process requires approximately 2 lb. of chlorine and 2 lb. of lime per lb. of ethylene oxide, while the only reactant in the direct

process, in addition to ethylene itself, is air. Since capital costs and other operating costs are reported to be about the same for both processes, the only real cost factor favoring the chlorohydrin process is its higher yield, usually about 75 percent.

Under present-day economic conditions, the relative costs of ethylene and chlorine will usually favor the direct process, even with a 55 percent yield. The favorable economic position of direct oxidation is emphasized still more with the higher yields of the Scientific Design process, which now begin to approach chlorohydrin yields.

Specific operating conditions of the SD process haven't been disclosed. This much is known: It uses a fixed bed of silver catalyst in a rugged form; no difficulty has been experienced by Naphtachimie in realizing good temperature control. It uses a modified recycle scheme and recovers all but 0.5 to 1 percent of the crude oxide as pure oxide. There is less magic in the process, however, than there is careful engineering study and balancing of all the operating variables, including the catalyst.

► **French Petrochemicals**—Naphtachimie was organized by three leading French firms—Pechiney, Kuhlmann, and Societe Generale pour les Huiles de Petroles (an affiliate of Anglo-Iranian Oil Co.). The plant is adjacent to a refinery of S.G.H.P. at the entrance to the Etang-de-Berre, on the Mediterranean coast southwest of Marseilles. It is said to be the only French plant making ethylene chemicals from petroleum sources.

United States dollars, through ECA financing, contributed about 10 percent of the \$20 million project, but most of the equipment and services were supplied internally in France. The project exemplifies, therefore, the type of technical assistance which has speeded the postwar recovery and modernization of European technology.

The new ethylene oxide plant completes a cycle which began in France more than 20 years ago with the discovery by Lefort of the basic feasibility of direct oxidation of ethylene. And the cycle may continue, for SD has arranged with Naphtachimie to make available to American industry the improvements and developments which will inevitably come with continuing commercial operation.

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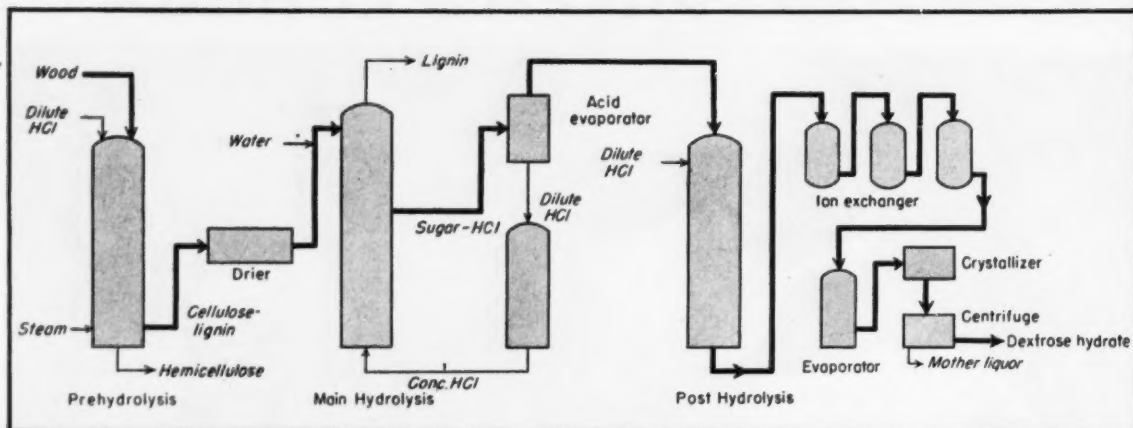
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REVAMPED RHEINAU PROCESS uses three-stage hydrolysis with hydrochloric acid to make dextrose from wood waste as . . .

Wood Challenges Corn as Dextrose Source

By aiming at high-priced dextrose instead of molasses—most common U. S. wood sugar target—German wood hydrolysis process makes bid for economic success.

Competitive sugar from wood waste, a long-pursued prize in both the U. S. and Europe, appeared to move closer to reality recently with the completion of encouraging cost studies of the revamped Rheinau wood saccharification process—hydrolysis with concentrated hydrochloric acid at low temperatures and pressures.

Warned by repeated failures of previous American and European experimenters to produce cheap wood molasses for livestock feed, the Germans have turned instead to the production of dextrose to compete with that made from corn. And latest cost estimates (using 1951 prices, see tables), if they can be substantiated, indicate potential success.

According to the figures, even if the price of corn should go down 20 percent, a drop that's not very likely under the present U. S. price support program, wood dextrose could still successfully compete with corn dextrose in a free market. In achieving this enviable position, the German researchers, led by Dr. Karl Schoenemann, Univ. of Darmstadt, point with pride to the changes in wood sugar conceptions they followed in modifying the Rheinau process.*

When surveyed by the Joint Intelli-

gence Objectives Agency in 1945 (Fiat Final Report No. 499), the process was deemed uneconomical. But since 1948 several important economies have been effected, according to Schoenemann.

Process losses were reduced from 13.2 to 2.1 percent of the entering sugar. Steam costs were cut 65 percent and electricity requirements were brought down 80 percent. In addition, the crystallizer volume needed per metric ton of dextrose was lowered from 99 cu. ft. to 7 cu. ft.

► **Find the Right Product**—Almost all early wood sugar processes were directed toward the production of molasses or alcohol via dilute-acid, high-temperature hydrolysis of wood chips. But none of these, including the original Rheinau hydrochloric acid process and the Madison sulfuric acid process—pilot-planted by Forest Products Laboratory and TVA—was consistently economical without government subsidy. Private attempts in this country to reopen the government-owned wartime alcohol-from-wood plant in Springfield, Ore., have all met with failure.

By turning to dextrose, however, the Germans have opened new vistas. Dextrose is not only preferred over cane and beet sugars in many canning operations, but is also a valuable chemical raw material, particularly in

the production of sorbitol and gluconic acid. These markets should mean a more stable price structure, a situation which wood molasses never had.

► **Key Changes in Process**—The new Rheinau process (see flowsheet) actually bears only superficial resemblance to the original, which was discovered in 1913 and consisted of a single hydrolysis step followed by crystallization. Yield of dextrose was only 20 percent of theoretical. By using three selective hydrolyses, plus ion-exchange demineralization, the modified process is claimed to yield up to 85 percent of the theoretical dextrose. Here's how it works:

Chipped wood waste—but not sawdust—is "prehydrolyzed" by batch-wise boiling with 1 percent hydrochloric acid at 265 deg. F. under pressure; this extracts easily hydrolyzed hemicellulose. On a dry wood basis, the yield of hemicellulose is 22 percent and can either be evaporated to a feed-molasses or fermented to alcohol.

The prehydrolyzed wood—containing essentially nothing but cellulose and lignin—is centrifuged, dried and passed to the main hydrolysis tower. Here the cellulose is converted to dextrose by countercurrent contacting with 41 percent hydrochloric acid at about 70 deg. F. Total time required is about 10 hours. Pure acid is then used to separate the resulting sugar solution from the lignin.

Lignin—30 lb. per 100 lb. of dry wood—is removed from the top of the towers with water and compressed

* Details are discussed in a paper presented by Schoenemann before the Congress of the Food and Agriculture Organization of the United Nations, Stockholm, July 1953.



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WHAT'S HAPPENING . . .

air and then pumped to a shaking sieve. Unlike the lignin produced in high-temperature processes, this by-product can be used in the production of phenol-formaldehyde resins. This is already being done in Germany.

► **Vacuum Evaporation**—Separation of hydrochloric acid from the concentrated sugar-acid solution is accomplished by three-stage vacuum evaporation. Pure hydrogen chloride is recovered from the first stage (at 100 mm. Hg abs.), 30 percent acid from the second (50 mm. Hg abs.) and 10 percent from the third by steam injection. The 30 percent distillate is then concentrated to the required 41 percent by adding hydrogen chloride gas, most of which is recycled from the first evaporator.

The sugar in solution at this point (70 percent concentration) contains about 50 percent di- and trisaccharides, which can be converted to dextrose by mild hydrolysis. Considerable research was carried out to determine the optimum time and temperature for this step, since both are extremely critical in the equilibrium between mono- and polysaccharides. High dilution of the sugar is also important, because the sugar equilibrium favors

depolymerization of the polysaccharides at low sugar concentrations.

Following the final hydrolysis, the dextrose solution is purified, demineralized by ion exchange, decolorized and evaporated in several stages under pressure. Lastly, the dextrose is crystallized centrifuged and dried.

► **Count the Costs**—In Germany, where corn production is very limited, there is every reason to expect a big future for the revised Rheinau process. In this country the situation is less clear-cut, but nonetheless worthy of careful study.

According to Schoenemann's cost analysis, production costs for wood dextrose in the U. S. would total 5¢/lb. By present corn saccharification methods, he estimates that dextrose cost 5.82 ± 1.0 ¢/lb.—allowing for fluctuations in byproduct values—in 1951.*

These figures depend a great deal, of course, on credits assigned to byproducts and on raw material costs. But even if the price of corn should drop from the chosen figure of \$1.70/bu.—determined from long-

*Based on production cost of A. E. Staley Mfg. Co.'s corn starch and corn sugar plant, Decatur, Ill. which produced about 50,000 tons of dextrose in 1951.

term corn and general price predictions—to \$1.35/bu., production costs of corn dextrose would just reach the calculated economical operating limit of the Rheinau process.

And all the wood byproduct prices appear conservative. Molasses is assigned its lowest prewar price, 8¢/gal. Sugar syrup from the mother liquor—mostly dextrose—at 10¢/gal. is only 25 percent above the molasses value. And only a tenth of the lignin produced is credited as a byproduct.

Construction costs for the 3,000 metric-tons-per-month U. S. hydrolysis plant were calculated from the detailed design of a smaller plant in Germany using appropriate conversion factors. Operating costs were based on American cost estimation methods¹ and other costs on a TVA calculation for the Madison process.²

It should be remembered, however, that there are only a few places in this country—primarily on the West Coast—that could support an installation of this size. And it's doubtful that even those could supply wood waste sufficiently free of sawdust and bark to allow its efficient use in the Rheinau process.

► **Surveying the Market**—The com-

Wood Dextrose Production Costs

Basis: dollars per 100 lb. of crystallized dextrose hydrate, total production of 6.61 million lb. per month (3,000 metric tons).

	Quantity	Price per unit, cents	Cost, dollars
Raw and auxiliary materials			
Waste wood (dry substance).....	0.091 cord	447	0.41
Chlorine liquid.....	28 lb.	2.70	0.76
Natural gas.....	182 cu. ft.	0.0168	0.03
Other auxiliaries.....			0.37
Paper bags (100 lb.).....	1 bag	22	0.22
Total raw material costs.....			1.79
Credits for byproducts			
Prehydrolysis molasses (50% reduced sugar).....	12 gal.	8	0.96
Sugar syrup from mother liquor (50% reduced sugar).....	4.6 gal.	10	0.46
Lignin (dry substance).....	10 lb.	3.2	0.32
Total byproduct credits.....			1.74
Raw materials less byproduct credits.....			0.05
Power			
Steam.....	1,230 lb.	0.067	0.82
Electricity.....	34.6 kwh.	0.63	0.22
Water.....	2,420 gal.	0.0012	0.03
Total power costs.....			1.07
Operating labor (including social contributions)			
202 skilled and unskilled workers, 42 hr. per week.....	0.55 man hr.	160	0.88
Supervision (30% of operating labor).....			0.26
Maintenance			
6% per year of \$6.4 million apparatus investment.....			0.52
2% per year of \$1.38 million building investment.....			
Supplies (15% of maintenance).....			
			0.08
General services			
60% of labor, supervision, maintenance and supplies.....			1.05
Amortization			
10% per year of \$6.4 million apparatus investment.....			0.89
5% per year of \$1.38 million building investment.....			
Taxes and insurance (2% of total investment).....			
			0.20
Total production costs.....			5.00

Corn Dextrose Production Costs

Basis: dollars per 100 lb. of crystallized dextrose hydrate, total production of 10 million lb. per month (4,260 metric tons).

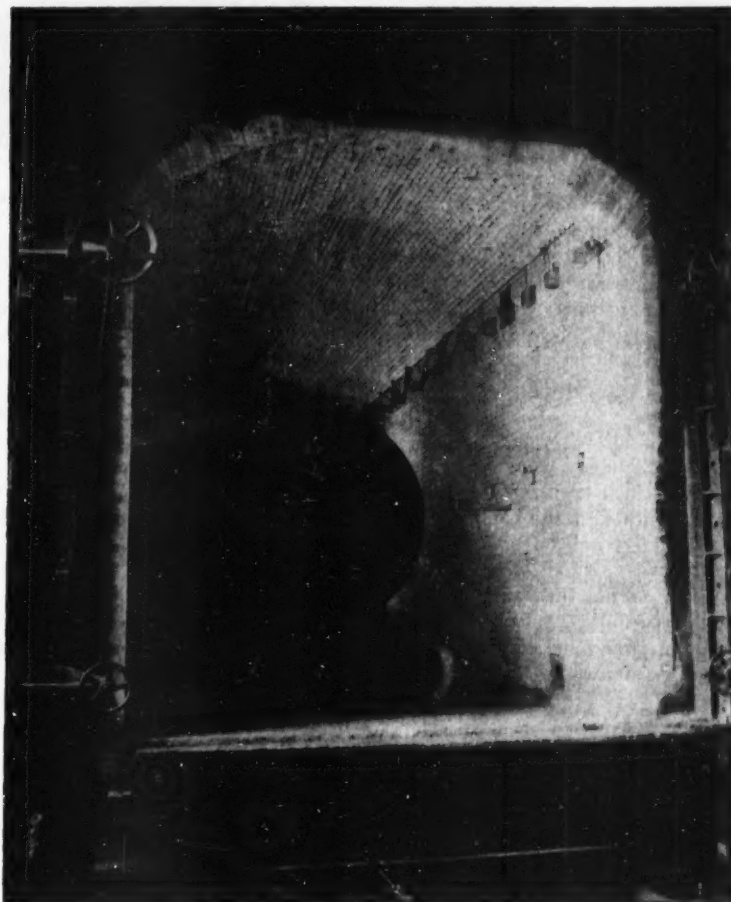
	Quantity	Price per unit, cents	Cost, dollars
Raw and auxiliary materials			
Corn, 14% water.....	3.23 bu.	170	5.50
Sulfur.....	0.48 lb.	1.1	0.01
Sulfuric acid, 95%.....	1.12 lb.	2.10	0.02
Bentonite.....	3.7 lb.	3.1	0.11
Absorption coal.....	1.5 lb.	15.0	0.23
Caustic soda, 76%.....	1.42 lb.	3.75	0.05
Paper bags (100 lb.).....	1 bag	22	0.22
Total raw material costs.....			6.14
Credits for byproducts			
Raw corn oil.....	4.9 lb.	15	0.74
Stock feed (26% protein).....	56.5 lb.	3.0	1.69
Total byproduct credits.....			2.43
Raw materials less byproduct credits.....			3.71
Power			
Steam.....	712 lb.	0.067	0.48
Electricity.....	11.9 kwh.	0.63	0.08
Water.....	48.3 gal.	0.0012	0.01
Lighting gas.....	198 cu. ft.	0.0168	0.03
Total power costs.....			0.60
Operating labor			
	0.15 man hr.	160	0.24
Supervision			
	30% of operating labor.....		0.07
Maintenance			
	5% per year of \$6 million apparatus investment.....		0.26
Supplies			
	15% of maintenance.....		0.04
General services			
	60% of labor, supervision, maintenance and supplies.....		0.37
Amortization			
	8% per year of \$8.1 million total investment.....		0.42
Taxes and insurance			
	2% per year of \$8.1 million total investment.....		0.11
Total production costs.....			5.82

ONLY *COMPLETE* STRESS RELIEF GUARANTEES SAFETY!

Naturally, with more than 50 years of metal fabrication experience behind us, we take every sound step to assure both safety and quality.

Steel tank seams, for example, are first welded then every inch of those seams is x-ray inspected. It is our belief that even this painstaking procedure isn't quite enough! That's why, as a final safety measure, we completely stress relieve each U-68 tank. Only in this way can we offer you a finished product equal to our traditional standards of quality.

If you would like to combine such quality and safety with a reasonable, competitive price why not call in your nearby **A.C.f.** Representative. It will pay to get *all* the facts before you buy! American Car and Foundry Company, New York • Chicago • St. Louis • Cleveland • Washington • Philadelphia • San Francisco.



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WHAT'S HAPPENING . . .

petitive position of dextrose from wood will naturally be affected by the price of corn. But a 20-year market analysis points up the comforting fact that dextrose prices have never varied as greatly as those of corn. Instead, they more closely follow the price of sucrose and the wholesale index.

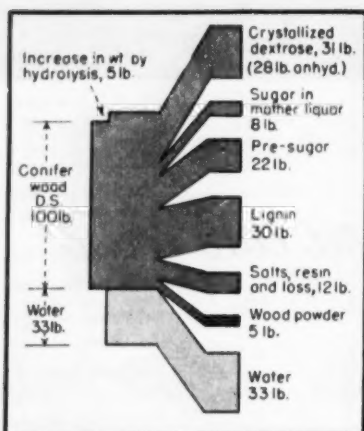
This means that a producer of wood dextrose would not be completely at the mercy of a rapidly shifting corn market and could count on a relatively stable profit margin. And deduction of normal transportation and wholesaling costs (1.2¢/lb.) from the average wholesale price in 1952 of 7.3¢/lb., certainly leaves an attractive profit—22 percent of the dextrose cost, 16 percent of the dextrose plus by-products cost.

This estimated price structure leaves corn dextrose an improbably small profit, less than 0.3¢/lb. One explanation for the discrepancy is that corn and feed prices declined sharply during much of 1952, indicating that Schoenemann's assumed production costs for corn dextrose may be too high.

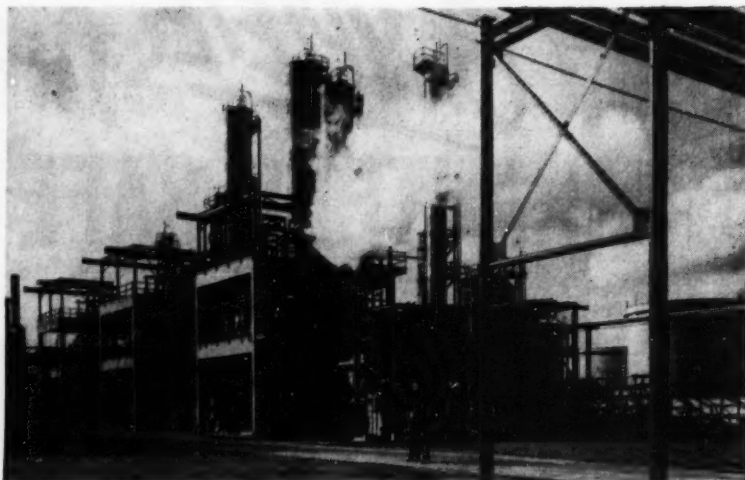
Nevertheless, the Rheinau process looks highly competitive, assuming that Schoenemann's results can be duplicated in this country. And if current research on better lignin utilization and on the possibility of charging sawdust instead of wood chips is successful, the process is likely to appear even more attractive to American investors.

REFERENCES

1. Newton, D. D. and Arles, R. S., *Ind. Eng. Chem.*, 43, p. 2304, 1951.
2. Gilbert, N., Hobbs, J. A. and Levine, J. D., *Ind. Eng. Chem.*, 44, p. 1712, 1952.



PROCESS YIELDS high percentage of dextrose and pre-sugar with little loss.



Sun's New Petrochemical Plant

Petrochemicals are now being produced in the new \$15 million plant of Sun Oil Co. at its Marcus Hook, Pa., refinery. Each year the plant can turn out 19 million gallons each of benzene and toluene and 15 million gallons of mixed xylenes. The aromatics are manufactured by catalytic reforming, using Houdriforming, developed by Houdry Process Corp. Final purification is by the Udex process of Universal Oil Products Co. and Dow Chemical Co. and by superfractionation.

Production of these basic aromatic chemicals from this one plant will equal one-fourth of their total U.S. production by the entire coal tar industry in 1941—the last year in which the United States had to rely exclusively on coal tar for many chemicals now made from petroleum.

The new Sun plant sprawls over 20 acres. It circulates about 170,000 bbl. of materials a day, or more than many complete refineries, not counting 44,000 gpm. of cooling water.

Three processing steps are incorporated in the new plant, all operating continuously. First is superfractionation of selected feedstocks from crude oil and natural gas. Next comes reforming at temperatures above 900 deg. F., using a platinum catalyst valued at nearly \$10 per lb. The final step is purification by a solvent process and further superfractionation.

Heart of the plant is the Houdriformer, where the aromatics are actually made by catalytic reforming. It has four pairs of cases with a furnace

before each case. The cases contain a platinum catalyst, which operates in the presence of hydrogen at over 900 deg. F. and 300 psi. to convert cyclohexane and methylcyclopentane into benzene and hydrogen. The methylcyclohexane and dimethylcyclopentanes are converted to toluene and still more hydrogen.

Over 13 million cubic feet per day of high-purity hydrogen is produced as a valuable byproduct of benzene and toluene manufacture. Actually, this hydrogen is withdrawn from an even greater torrent of hydrogen that is continuously recycled to the catalyst cases to prevent deactivation of the catalyst, which never needs regeneration.

After separation of hydrogen, the liquid product from the catalytic reforming cases is depentanized. The bottoms from the depentanizer, while rich in benzene and toluene, must still be further processed in the Udex unit.

In the first tower of the Udex unit the benzene-toluene rich stream flows countercurrently to a diethylene glycol solution. The glycol dissolves the benzene and toluene from the contaminating hydrocarbons. In the second tower the benzene and toluene are separated from the glycol by distillation. The glycol is then returned to the extraction tower.

High-purity benzene and toluene from the Udex unit are finally cleaned up in clay treaters. The purified aromatics then pass through two more distilling columns. From the first comes nitration-grade benzene and

Case No. 58

Results Bring Re-Order
from Heyden Chemical
Corp. for Second Kemp
Inert Gas Generator

Heyden Chemical doubles its blanketing savings with Second Kemp Generator

HERE'S A CASE where simple mathematics paid big dividends at this Garfield, New Jersey plant. When Heyden Chemical—one of the nation's leading producers of formaldehyde, pentaerythritol, salicylic acid, etc.—installed its first Kemp Inert Gas Generator to furnish CO_2 for blanketing a special grinding operation, it was on more or less a test basis. Part of Heyden's constant search for newer, better, cheaper ways to improve its products. The rest of its blanketing needs were still being handled with CO_2 from large storage tanks in the plant.

Immediate Savings with Kemp

Results with the first Kemp Inert Producer were impressive. Now a second (see right) Kemp unit has been installed and actual savings over previous costs are estimated at over \$500 a month for the first year. In addition to dollars saved, Kemp Generators assure a safe, dependable supply of chemically clean inerts. Deliver inerts at a special analysis . . . without fluctuations.

Kemp Designs Versatile

If you still rely on old-fashioned inert sources or are dissatisfied with present inert equipment, let Kemp help you, too. Kemp Engineers will be most happy to help solve your inert problems . . . show you how you can get similar results with fast-starting, easy-to-operate Kemp Generators. It costs you nothing to investigate. And it may save you real money.

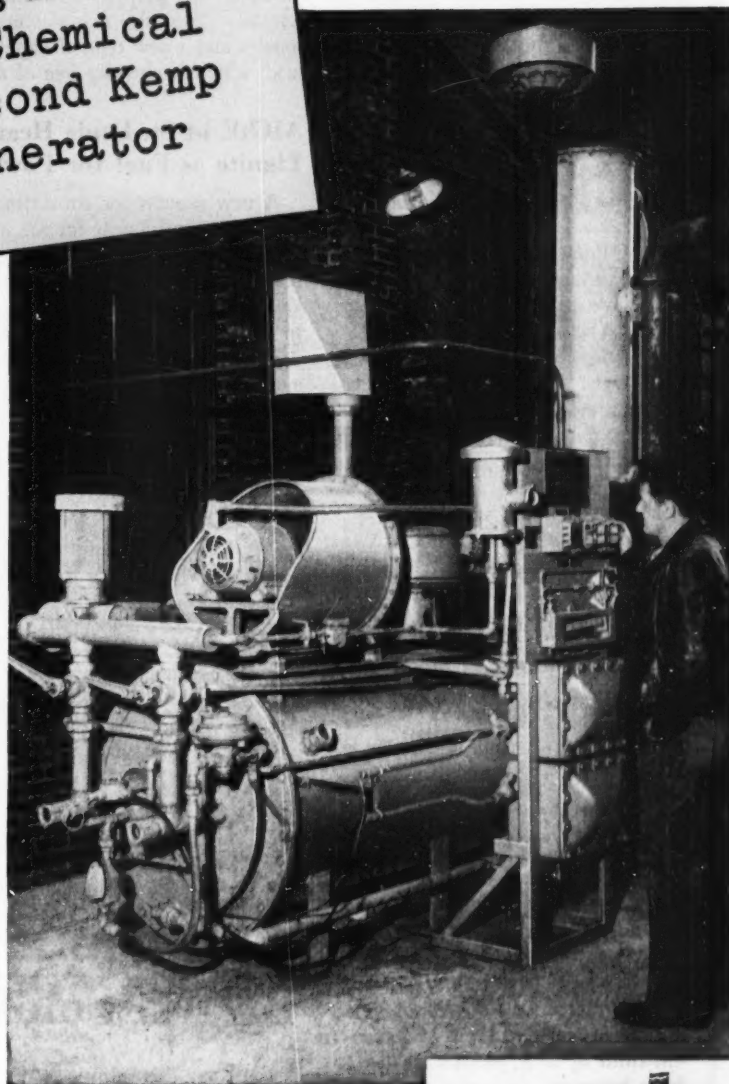
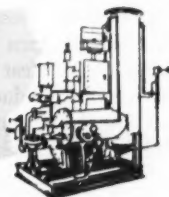


Photo at right shows close-up view of Kemp Industrial Carburetor. Part of every Kemp installation, it eliminates tinkering, waste. Assures complete combustion at all times. Reduces installation costs and maintenance.



For more complete facts and technical information, write for Bulletin I-10 to:
C. M. KEMP MFG. CO., 405 East Oliver Street, Baltimore 2, Maryland.

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INERT GAS GENERATORS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • ADSORPTIVE
DRYERS • SINGEING EQUIPMENT

WHAT'S HAPPENING . . .

from the second, nitration-grade toluene.

The Houdriformer runs alternately on benzene-toluene feedstock and xylene feedstock in a blocked-out operation. The Houdriformer operates on the xylene feed much as it does on the benzene-toluene feed. The principal difference is a higher pressure—around 500 psi. Again over 13 million cubic feet per day of hydrogen is produced.

The liquid product from the catalytic reformer during xylene manufacture is fed to two distilling towers in series. The first recovers a light gasoline, the second a naphtha stream. A third tower separates the final xylene product from a small amount of higher boiling aromatics.

The reason that xylenes can be recovered by careful fractionation instead of by elaborate processing is that the feed to the Houdriformer is cut so it contains virtually nothing boiling above 265 deg. F. Since the lowest boiling xylene boils at about 277 deg. F., it is possible to fractionate the xylenes formed in the operation from the unconverted part of the feed.

Of high purity, the products of the plant are essential not only for many of the country's peacetime industries but also have important defense uses.

Toluene is an essential for TNT manufacture. It is also used in aviation gasoline and as a lacquer solvent.

Benzene, one of the most important chemical building blocks, goes into synthetic rubber, which alone takes 20 percent of the nation's present petrochemical supply. More than one-third of U.S. plastics are derived from benzene. It is also used in detergents, DDT and other insecticides and pesticides, dyes, nylon, paints and pharmaceuticals.

Xylenes are used in the manufacture of lacquers, solvents, paints and plastics.

Ethylbenzene, produced with the xylenes, is the starting material for styrene, used in synthetic rubber, plastics and paints. Ortho-xylene can be used instead of naphthalene in the manufacture of phthalic anhydride. Meta-xylene is beginning to have commercial importance as a source of isophthalic acid. And para-xylene is already used in the manufacture of Du Pont's synthetic fiber Dacron.

The new aromatics plant is a major

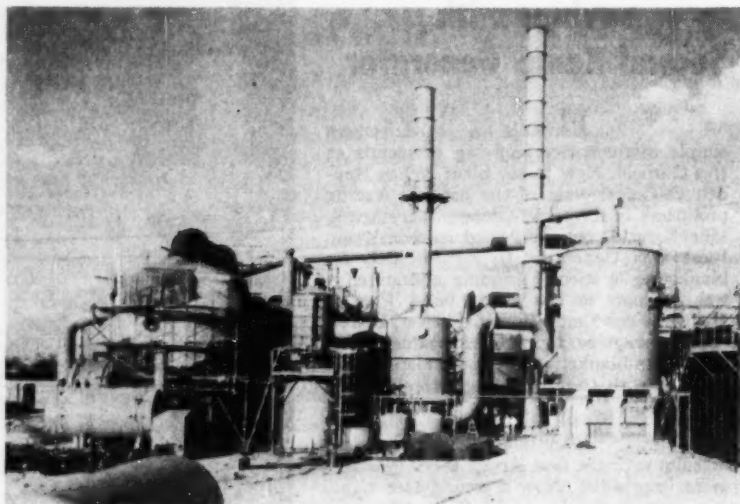
step in Sun's movement into petrochemicals. Sun is already a large producer of propylene trimer and tetramer. Sun also manufactures sulfonates and a new type of naphthenic acid, which is virtually free of oil.

AICHE in St. Louis Hears of Lignite as Fuel for Power

A new process for converting low-grade coals and lignite for use in electrical power generation was described recently to the American Institute of Chemical Engineers in St. Louis, Mo., by V. F. Parry of the U.S. Bureau of Mines. The lignite is treated in a

fluidized dryer, in which fine particles are suspended in hot gases. The dried lignite is then suitable for fuel in a power plant, according to Parry, or it can be further processed into a coke material.

A plant using this technique will soon be in operation at Rockdale, Tex., for the generation of 240,000 kw. of electrical power. The plant is being built by Texas Power & Light Co. for the Aluminum Co. of America. A trial unit is being built to study the carbonizing operation. This produces a byproduct tar, whose value has not yet been established, since it is a new material.



Biggest Sulphuric Plant Ever

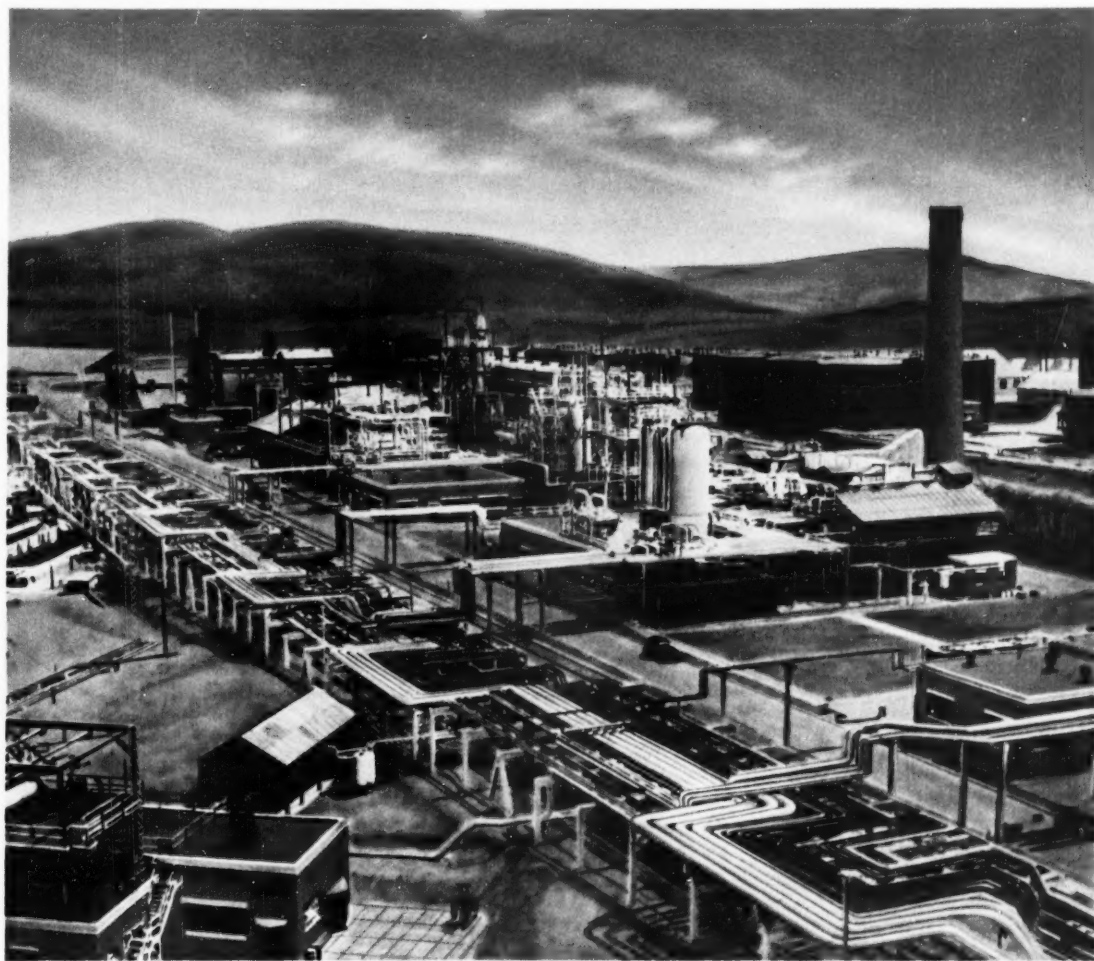
Each day this sulfuric acid plant at Bartow, Fla., can turn out 550 tons of 100 percent acid, making it the world's largest producer of sulfuric, according to Monsanto Chemical Co., its designer. The acid plant is part of the new \$12 million triple superphosphate plant of Davison Chemical Corp. at Bartow.

Davison's new acid plant employs the contact process. Sulfur is burned to give sulfur dioxide, which is converted by catalytic contact to sulfur trioxide. This is then absorbed to give sulfuric acid. Heat from the reaction is used to produce steam for power in the triple superphosphate plant and in the acid plant.

Equipment of the acid unit includes molten sulfur filters; storage facilities for 8,400 tons of sulfur and 6,000 tons, in three tanks, of acid as 66 deg. Baume acid; a converter 39 ft. high and 24 ft. in diameter; and absorbing and drying towers 34 ft. high and 24 ft. in diameter. These towers are of steel, brick-lined and packed.

Capacity of the triple superphosphate plant is rated at 200,000 tons annually, which is estimated to make Davison the second largest producer. Initially, the entire output of the acid unit will be required in the main process. Later, there may be a surplus of acid for sale.

(For more of What's Happening in Chemical Engineering, turn to page 384)



ON A HILLSIDE IN SOUTH WALES

Llandarcy, the Anglo-Iranian Oil Company refinery situated on a hillside near Neath, South Wales, has grown since 1946 from 360,000 tons to 4,000,000 tons capacity per year.

In this development program Badger Process Division of Stone & Webster Engineering Corporation, and its affiliate, E. B. Badger & Sons Limited, have played a major part.

Some of the new and modern facilities already completed or under construction are crude distillation, catalytic reforming, propane deasphalting, furfural extraction, solvent dewaxing, wax manufacturing and clay treating.



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BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS LIMITED

Neoprene Latex Clothing



Protective Clothing

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for Refinery and Oil Field Workers
— against oils, greases,
acids and alkalis!

Made of Neoprene Latex, these AO garments are *saturation-coated* for long life. They won't peel, blister or crack yet they're lightweight, contain no heavy "loaders". Highly flexible, they won't stiffen in cold weather or become sticky in hot. They are easy to clean — tub 'em, scrub 'em or clean them with petroleum solvent — AO Neoprene Latex Clothing can take it. Illustrated and described are three of the nine garments in the line. Yellow is the most popular color for *safety*, but black is also available on special order. In addition to the items illustrated, AO offers Coveralls, Police coats and All-weather Hoods.



901 COAT — $\frac{3}{4}$ length (44") all sizes. Two side pockets with an overlapping storm front and button fasteners. Standing corduroy-lined collar. No vent or slit in tail of coat. Long coats 50" — 54" are also available. 922 Sou'wester type hats in all sizes.



902 SUIT JACKET — Has button fasteners, storm front and corduroy collar. 30" long from collar to tail. No seam in back.

913 PANTS — Over-all bib type pants with cross-back suspender straps having bar fasteners that attach to two buttons at top of the bib. Safety fly front featuring an overlap which prevents entrance of oils or chemicals or other liquids. Waist type pants are also available.

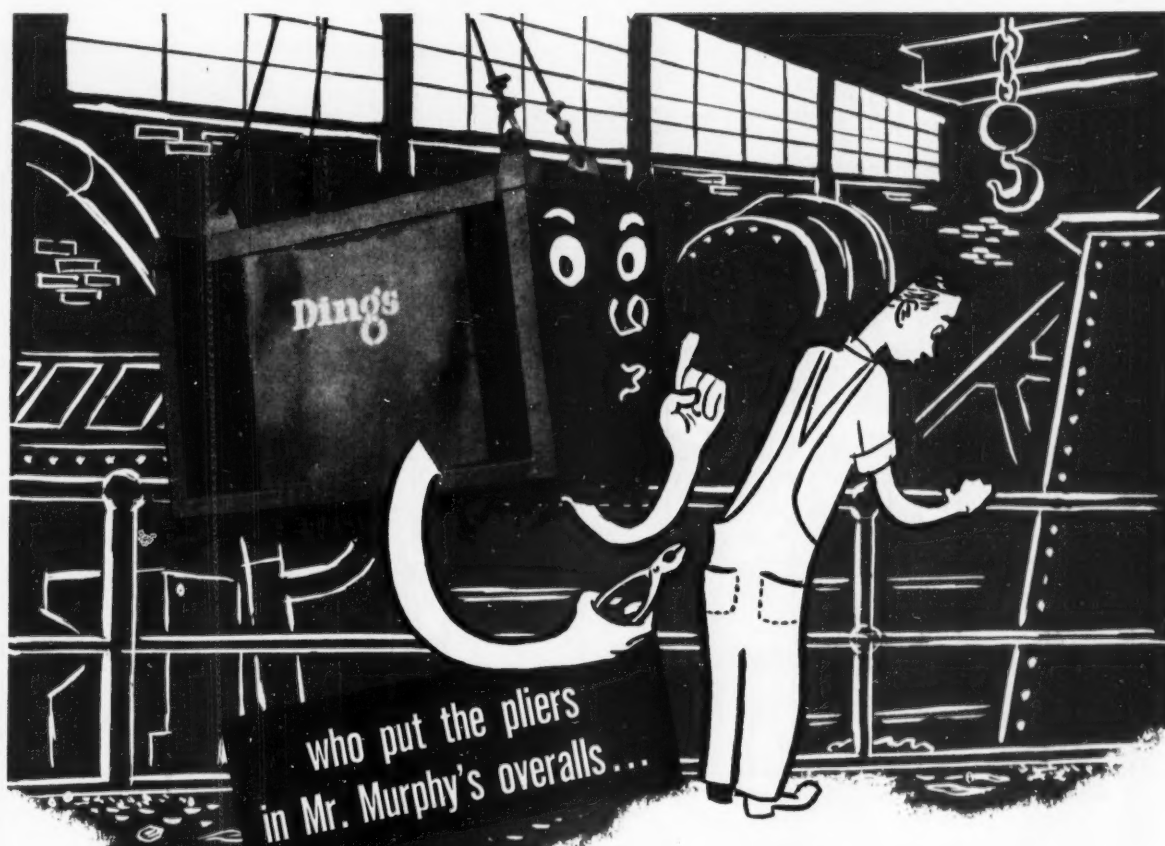
Your nearest AO Safety Products Representative can supply you



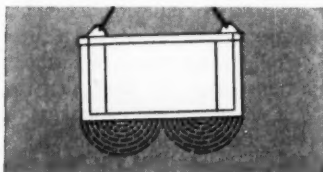
Look to AO for a complete line of safety goggles, protective clothing and respirators for every industrial need.



SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES



THIS IS THE MAGNET THAT CAUGHT THE PLIERS — That junk on the bottom is a typical tramp iron accumulation—crushed "tin" cans, wire. "Murphy" reports even crowbars occasionally find their way into the corncocks processed in his plant.



HERE'S HOW IT WORKS — The Dings RM Magnet can be suspended over conveyor belts, installed on chutes or liquid lines. There isn't a more powerful tramp iron magnet than this triple-poled unit. Its field is deeper and longer, and it's available in a complete range of sizes and magnetic strengths. Complete details in Catalog 1315-A.

DINGS MAGNETIC SEPARATOR COMPANY

4730 W. Electric Ave., Milwaukee 46, Wis.

RM-154

MURPHY is what we'll call the chief engineer in the Omaha chemical plant of one of the nation's largest grain processors.* Here's his story —

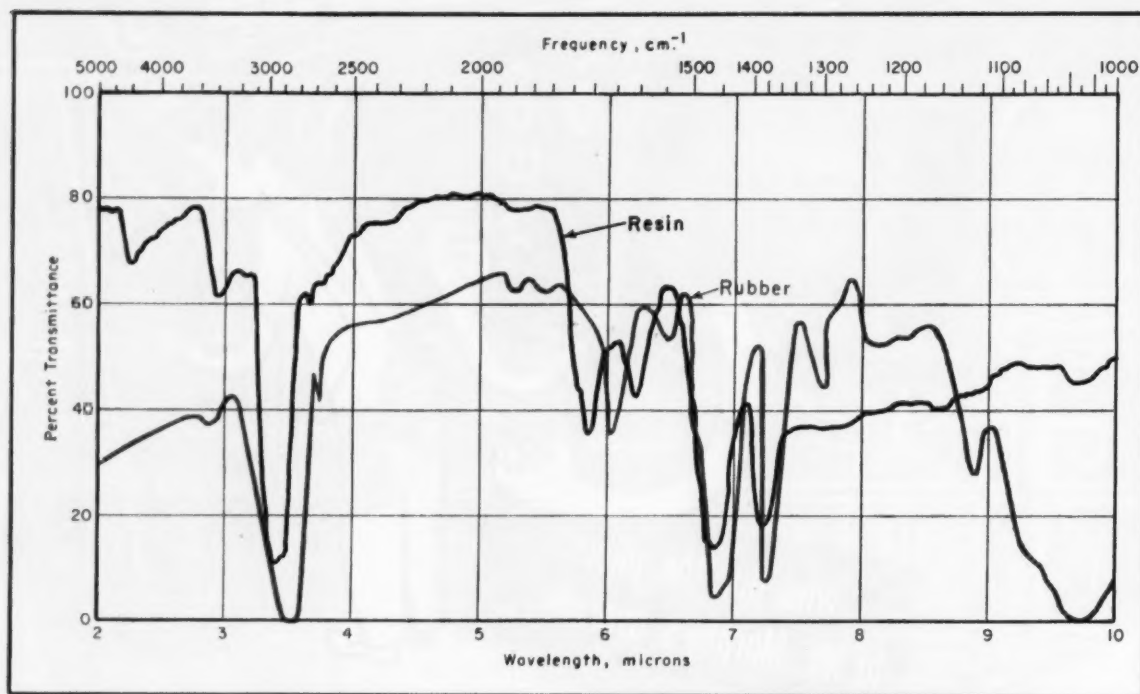
One day, not long after his Dings RM Suspended Tramp Iron Magnet was installed, he was wishing he had a pair of long nosed pliers. Shortly after, one of his men walked up and handed him a pair. They'd been pulled out of a 12-inch conveyor belt burden of corncocks by the Dings RM Magnet.

Murphy was awfully glad to see those pliers and not just because he wanted a pair. He was thinking of what they would have done to the hammermills and other processing equipment fed by that conveyor, if they hadn't been caught by the Dings Magnet.

You might think about that, too. What's it costing you to "process" tramp iron in your plant? It isn't necessary. Your Dings representative can show you an economical way to eliminate tramp iron with a Dings Magnetic Separator.

*Name and complete details on request





INFRA-RED ANALYSIS of new rubber processing resin shows it to have very close structural similarity to natural rubber.

Rubber-Like Resin Aids Compounders

Having a structure very similar to natural rubber, new resin blends easily with both natural and synthetic rubbers, maintaining flexibility even after severe aging.

High compatibility with natural rubber, GR-S, Neoprene, butyl and other synthetics marks the entrance of Solarite Resin #11 into the rubber processing resin market.

Described as having characteristics specifically tailored for maximum value to rubber compounders and users, the new product is easily incorporated, dispersed and processed without "mushiness" and maintains flexibility despite severe aging or exposure to ozone. It's suitable for pure gum or highly loaded stocks and has excellent electrical characteristics.

In addition, stocks processed with Resin #11 possess marked freedom from scorching and bin-curing and maintain viscosity over extreme temperature variations.

► **Transmits Like Rubber**—Although a synthetic hydrocarbon resin, one of the most interesting properties of Solarite Resin #11 is its close structural similarity to natural rubber, as shown by infra-red analysis (see cut). Absorption of infra-red, as indicated by the "dips," is strongly marked at approximately the same wave lengths for both compounds.

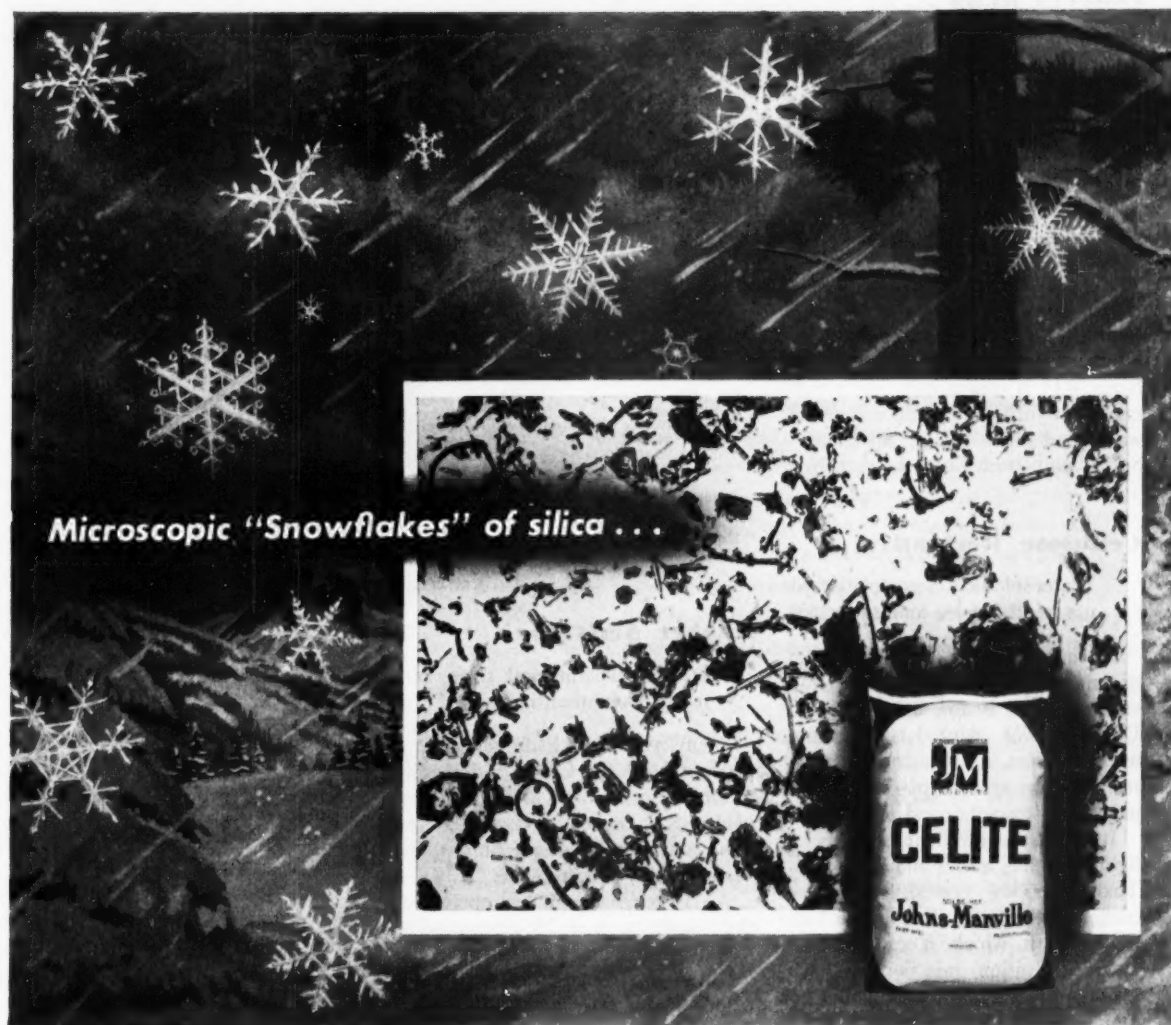
It would be expected, then, that such a resin would contribute greatly to the physical properties of rubber compounds. Bearing this out is the fact that when the resin is heated to its melting point it can be stretched considerably. For these reasons, Resin #11 can be thought of as a "fossil rubber" rather than as a resin in the generally accepted sense.

► **Freely Available**—The new product can be produced in large quantities from freely available domestic raw materials. It's possible, therefore, that it may someday be of interest as an alternate source for compounds now derived from coal tar and petroleum.

Currently, desirable coal tar resins are in short supply due to the steel industry's growing trend toward greater use of its own byproducts. And in the event of further international crisis, it's likely that the supply of petroleum and natural gas resins will be adversely affected.

► **Compares Well**—Neoprene and GR-S compounded with Resin #11 show up very favorably against those using prominent competitive resins. In Neoprene, for example, the Solarite product gives generally better elongation characteristics—both before and after accelerated aging tests—and usually greater tensile strength.

When incorporated into butyl rub-



Microscopic "Snowflakes" of silica . . .

Celite's diatomite structure steps up performance in paints—plastics—polishes . . . hundreds of other products

MICROSCOPIC PARTICLES of Celite* do a man-size job of stepping up performance for many of America's leading products. Here is how the unique structure of Celite Diatomite Powders may add more beauty, longer life, greater efficiency to *your* products, too.

For example, the spiny, irregularly shaped particles contribute surface characteristics which make them the outstanding flattening agent in paints. Again, because of their structure, Celite particles are widely used as a

mild, non-scratching abrasive in finest quality auto, silver and glass polishes. Or consider molded plastics, where the strength and durability of Celite particles add life and beauty to surface finish.

Moreover, Celite particles in mass have great bulk per unit weight, so they are invaluable for extending, dispersing or fluffing up dry powders. They have high absorptive capacity, too, so they keep powders free-flowing, they serve as a medium for shipping

or storing liquids in a dry form.

Which of the many Celite advantages can you use to build product performance or cut production costs? A Johns-Manville Celite Engineer will gladly discuss your problem, without obligation. For his services or more information, simply write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

*Celite is Johns-Manville's registered Trade Mark for its diatomaceous silica products.



Johns-Manville CELITE

INDUSTRY'S MOST
VERSATILE MINERAL FILLER

PRODUCT NEWS . . .

ber, Solarite Resin #11 increases the Modulus (at 200 percent elongation) by 25-80 percent depending on the quantity of resin and upon the length of cure. Shore Hardness and elongation are also generally higher.

As shipped, the amber-colored lumps melt at 170-180 deg. F. and have a specific gravity of 1.01-1.02. The product is nonsaponifiable, resistant to alkalis, acids and water and soluble in aromatic and aliphatic hydrocarbons. In addition, Solarite Resin #11 is compatible with a wide range of synthetic and natural resins, waxes and other organic substances—Solar Compounds Corp., Linden, N. J.

Cellulose Derivative

Water-soluble, thermoplastic for use as thickener and surfactant.

Methocel X-2602, a water-soluble, thermoplastic hydroxypropyl methyl cellulose ether is now being made by Dow in pilot plant lots. Research work indicates uses as a thickener and surface active agent in plastics, gelatin, paint, ink, cosmetics and food.

It possesses excellent stability to light, air-aging, alkalis and weak acids. Toxicity is low enough for use in cosmetics and foods. Fabrication techniques with which it can be used include extrusion, injection and compression molding, hot casting and hot dipping.—Dow Chemical Co., Midland, Mich.

Plasticizer

For pigmented and colored vinyls; it's low cost and non-toxic.

Now you can get a new, low-cost extender-type plasticizer for vinyls. Trade named HB-20, the new material is a partially hydrogenated alkyl-aryl hydrocarbon, which also shows promise as a plasticizer for polystyrenes, ethyl cellulose and asphaltic compositions.

Due to a cost lower than several similar products, the water white, high boiling, and practically odorless liquid will probably have its best acceptance in pigmented and colored vinyls. Preliminary tests have shown HB-20 to be practically non-toxic from an acute point of view.—Phosphate Div., Monsanto Chemical Co., St. Louis 4, Mo.

A capsulated listing of this month's newsworthy products.

It's New . . .	It's Good for . . .	See Page . . .
Rubber-Like Resin	Incorporating in natural and synthetic rubber	148
Cellulose Derivative	Thickening plastics, gelatin, paint and foods	150
Plasticizer	Pigmented and colored vinyls	150
Rubber Activator	GR-S cold rubber formulations	150
Organic Sequestrants	Chelating ferric ions, calcium and divalent metals	150
Herbicide	Controlling deep-rooted perennial weeds	150
Antirust Paint	One coat applications that last up to ten years	152
Molding Resin	Arc resistant parts	152
Galvanizer	Applying with brush, spray gun or by cold dip	152
4-Vinylpyridine	Making high-melting polymers	152
Silicone Spray	Sharply cutting defoaming times	152
Aluminizer	Metallizing surfaces with aluminum without heat	154
Resin Raw Material	Making resins that fall between urea and melamine	154
Phenolic Resins	Use in protective coatings	154
Pre-Processed Resins	Standardized, reproducible laboratory application	154
Plasticizers	Giving low-temperature flexibility to PVC resins	154
Safety Solvent	Replacing carbon tetrachloride	154
Textile Water Repellent	Wool, acetate, nylon, acrylic and polyester fibers	156
Unsaturated Amines	Lubricant additives and emulsifiers	156
Thioglycolate Ester	Making substituted amides of thioglycolic acid	156
Indelible Colored Inks	Identifying fabrics, paper, metals and plastics	156
o-Methylstyrene Dimers	Modifying polymerization reactions	156
Buna N Development	Good heat and oil resistance	156
Emulsion Thickeners	Breaking emulsion adhesives	156
Carbon Black	Greater flexibility in formulations; extra volatile	156

Rubber Activator

Still in experimental stage, but results look promising.

Phenylcyclohexyl hydroperoxide, a new activator for GR-S cold rubber formulation, has been used to prepare cold GR-S rubber in less than 20 min. at 41 deg. F.—many times faster than ordinary processes.

A very active organic hydroperoxide, the substance is a 20 percent solution of phenylcyclohexane hydroperoxide in phenylcyclohexane and is available only in experimental quantities. The product may also be good as a polymerization catalyst for other applications such as styrenated polyesters.—Monsanto Chemical Co., Phosphate Div., St. Louis 4, Mo.

Organic Sequestrants

Are effective over wide pH range and have high solubility.

A new series of organic sequestrants known as Perma Kleers has just been announced. These stable salts of poly-amino carboxylic acids are distinguished from EDTA—ethylene diamine tetra-acetic acid—by their high solubility, superior chelation of ferric ion and greater efficiency for sequestering calcium and divalent metals. The Perma Kleers react with metal ions to form water soluble chelates, deactivating them without actually removing them from solution.

These complexes are not precipi-

tated by such agents as soaps, oxalates or phosphates. The tendency to form metallic complexes is so great that most insoluble metal compounds are chelated. Of the common anions, only sulfides resist this force.

The new products are effective over a very wide pH range. Calcium is efficiently chelated down to pH 7. Ferric ion is sequestered well beyond pH 11 with only moderate loss in efficiency. And even when the complex is completely saturated with ferric ion, it still retains full chelating power for calcium, magnesium and divalent metals.

When the Perma Kleers are added to soaps and detergents an increase in foam and detergency is observed, similar to that observed with polyphosphates. This is said to be the result of the pronounced detergent-building properties of the compound.—Refined Products Corp., Lyndhurst, N. J.

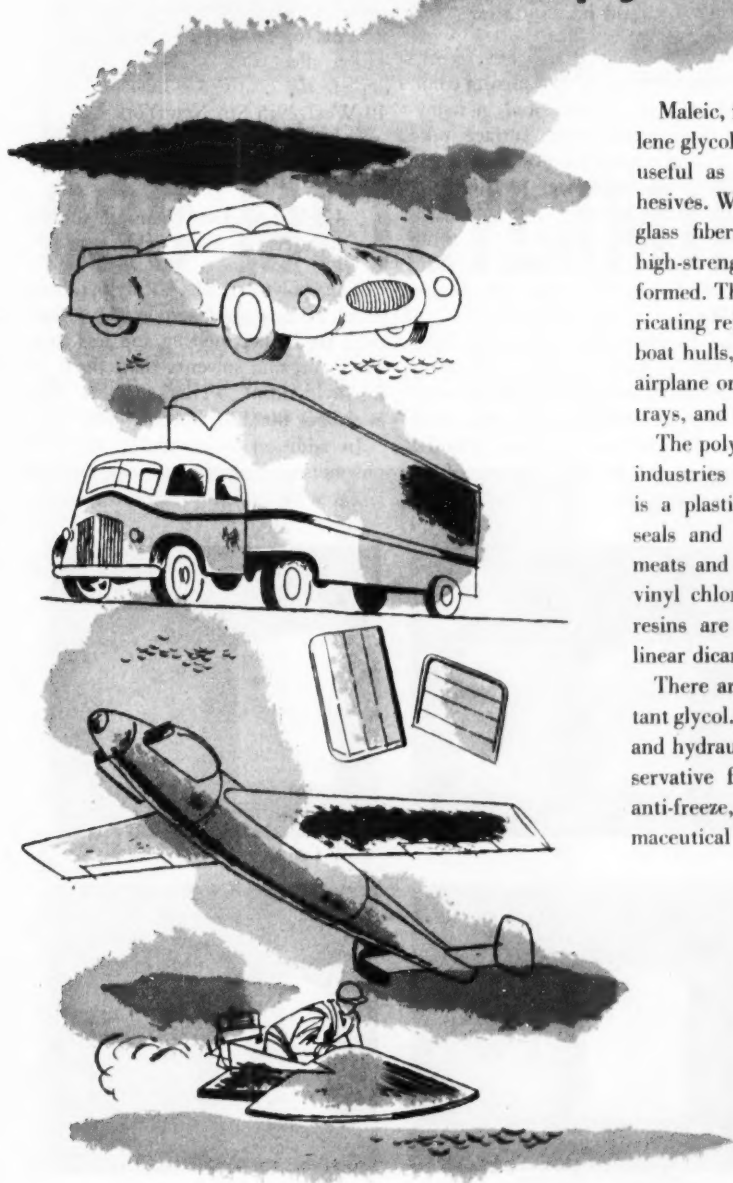
Herbicide

Controls such deep-rooted perennial weeds as Johnson grass and Bermuda grass.

Although not yet available in commercial quantity, phenyldimethylurea looks like a good bet for the control of deep-rooted perennial weeds. Tests by State and Federal experiment stations indicate effective control of bindweed, crab grass, Johnson grass and Bermuda grass. At the same time, concentration of the chemical is reduced to in-

Formulate polyester resins

WITH **CARBIDE'S** Propylene Glycol




Maleic, fumaric, or similar acid esters of propylene glycol, polymerized with vinyl monomers, are useful as low-pressure laminating resins or adhesives. When polyester resins are fabricated with glass fibers or fabric—lightweight plastics with high-strength and superior electrical properties are formed. These are important properties when fabricating reinforced plastics for automobile bodies, boat hulls, fuel oil tanks, washing machine parts, airplane or refrigerator parts, bathtubs, furniture, trays, and other structural materials.

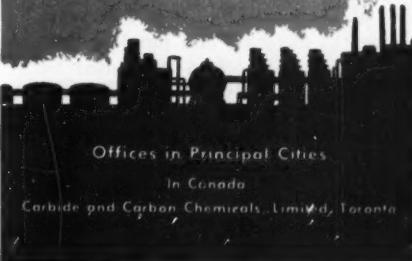
The polyester resin field is but one of the many industries utilizing CARBIDE's propylene glycol. It is a plasticizer for phenolic resin bonded cork seals and crowns and for cellulose casings for meats and cheese. Resinous plasticizers for polyvinyl chloride, polyvinyl acetate, and copolymer resins are prepared from propylene glycol and linear dicarboxylic acids.

There are other industries that use this important glycol. For example, it is a component of brake and hydraulic fluids, a hygroscopic agent and preservative for tobacco, an industrial coolant and anti-freeze, and a humectant and solvent for pharmaceutical formulations and cosmetic preparations.

CARBIDE's technical information or assistance is available at your request. Just call or write the CARBIDE office nearest you.

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PRODUCT NEWS . . .

nocuous levels in the soil in a reasonable period of time.

3-phenyl-1, 1-dimethylurea is a white crystalline compound melting at 127-129 deg. C. It is only slightly soluble in hydrocarbon solvents and is soluble in water at 24 deg. C. to the extent of 0.29 percent. In addition, tests have shown that inclusion of the compound in the diet of white rats to the extent of 0.05 percent for 90 days had no apparent adverse effect.—*F. I. du Pont de Nemours & Co., Inc., Wilmington, Del.*

Antirust Paint

One coat application is claimed to last up to ten years.

A new, one-coat, antirust paint for steel has just been announced. Called Adelphi One Coat Counter-Rust, it can be applied over any film of paint that's in fair to good condition. Minor rust spots already present are isolated and neutralized.

Almost ten years of development are behind this product. Because its film thickness equals three coats of conventional rust inhibitive paint, the manufacturer is confident that Counter-Rust will protect steel structures from corrosion for 5-10 years.

Solvents have been practically eliminated in the formulation to prevent formation of pinholes due to evaporation. High moisture resistance gives maximum protection to the metal.—*Adelphi Paint & Color Works, Inc., 86-00 Dumont Ave., Ozone Park 17, N. Y.*

Molding Resin

Has improved arc resistance and is dimensionally stable.

Monsanto has developed a new thermosetting molding material with improved arc resistance and excellent dimensional stability. The new material, Resinox 3700, is said to combine the electrical and physical characteristics most often demanded by molders and end users of arc-resistant parts.

The product's arc resistance has been measured at 184 sec. in standard A.S.T.M. tests and its good dimensional stability means that the problem of after-shrinkage, the objection to

most arc resistance materials now in use, virtually has been eliminated.—*Monsanto Chemical Co., Springfield, Mass.*

Galvanizer

A new method of cold galvanizing steel and iron surfaces.

Despite its considerably lower cost, Galvicon, a new cold galvanizing compound, is said to equal and in many cases out-perform other surface protection techniques for iron and steel, including electroplating, hot-dipping, cementation, spraying and painting. Although it's not a paint, the compound can be applied with an ordinary brush, electric spray gun or by cold dip.

The product differs basically from so-called metallic paints containing zinc in that it actually combines with the base metal, setting up electrical continuity and offering true cathodic protection. It leaves a coating of 96 percent by weight of chemically pure

zinc and 4 percent of a high molecular weight polymer.

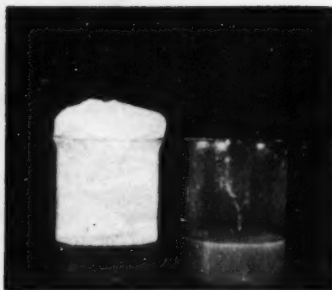
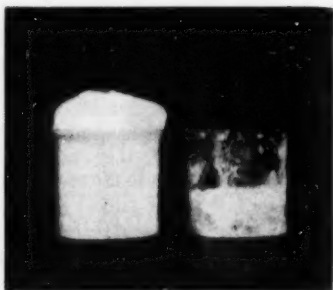
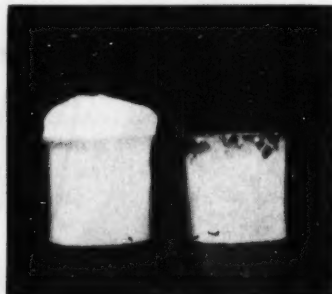
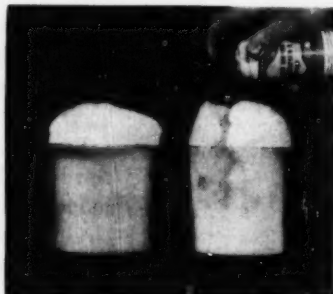
It can be applied to any iron or steel surface—new or old—that would be subject to corrosion. The longer Galvicon is exposed to moisture the harder the coating becomes. It is not recommended, however, where it would come in direct contact with petroleum solvents or chlorinated hydrocarbons which affect the bonding media and deplete the coating.—*Galvicon Corp., 40 West 29th St., New York 1, N. Y.*

4-Vinylpyridine

Highly reactive chemical should be useful in many fields.

The polymers of 4-Vinylpyridine, which is now in commercial production, are higher melting and less soluble in organic solvents than those of 2-Vinylpyridine. This suggests uses in rubber bonding formulations.

In addition to its ability to form polymers and copolymers, the product reacts with sulfurous acid to give py-



NEW SILICONE SPRAY SHARPLY CUTS DEFOAMING TIMES

Foam sprayed with a dispersion of Dow Corning's Antifoam A in Freon (beakers on right) disappears in seconds, even before the uninhibited foam begins to collapse by itself. Designed for speedy foam control in laboratories, pilot plants and other small scale processing, the new spray eliminates time lost waiting for the inhibitor to become effective by instantly blanketing the foam with a cloud of finely divided silicone. Effective concentrations of silicone are well below the 10 ppm. that FDA permits in food. And in most cases, no trace of the inhibitor can be detected in the finished batch after defoaming.—*Dow Corning Corp., Midland, Mich.*

Vulcanization Accelerators

In the manufacture of thiuram sulfide type of accelerators as well as dimethyldithiocarbamic acid metal salts.

Fuel

Internal coolant to improve the performance of reciprocating engines.

Herbicides

As a neutralizing and solubilizing agent in preparation of concentrated solutions of 2,4-D salts and mixtures of 2,4-D with 2,4,5-T.

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CSC Monomethylamine CH_3NH_2 , Dimethylamine $(\text{CH}_3)_2\text{NH}$ and Trimethylamine $(\text{CH}_3)_3\text{N}$ represent the most economical source of the amine group because of their low equivalent weights and moderate prices. Look how you can put these versatile amines to work for you.

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& Accelerators

As catalysts where alkaline conditions are required for polymerization.

Textiles

To improve affinity of cellulose acetate rayon for direct cotton dyes.

In the manufacture of long-chain quaternary ammonium compounds for use as softeners, lubricants, and water-proofing agents.

Surface-active agents

In the manufacture of amide and sulfonated amide-type detergents and surface-active agents.

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Inhibits polymerization of unsaturated hydrocarbons during distillation.

Used as a stabilizer for certain types of resins.

Used to reduce webbing of natural and synthetic rubber latexes during dipping operations.

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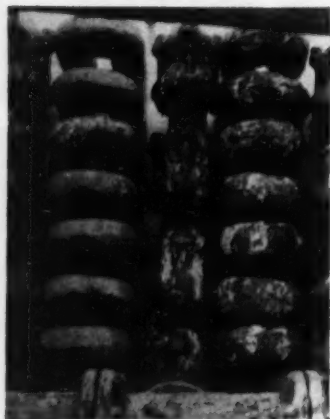
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ridylethane sulfonic acid, with nitrous acid to give nitroethylpyridine, with alcohols to give pyridylethyl ethers and with amines to give pyridylethyl amines.—Reilly Tar & Chemical Co., Indianapolis 4, Ind.



Aluminizer

Makes it possible to metalize surfaces with aluminum without heat.

Kolmetal, a mixture of finely pulverized aluminum in a plastic base, can be used to coat surfaces with aluminum without the use of heat. The resultant coating, achieved by two applications with a 4-hour drying time between, is air-hardened to a plastic bonded aluminum surface which can be polished, ground, rolled or bent to a 45 deg. angle without chipping or cracking.

Comparison of cooling coils after two years of service in a salt river water with a pH between 4 and 5 (see cut) shows coated coils on the left to be free from scale, salt or corrosive matter of any sort. Those on the right, which were uncoated, show a heavy build-up of rust, scale and organic growth. The coating retains its finish and firm adhesion over a wide range of temperatures.

Kolmetal is recommended as a coating for the interior of all types of tanks. It proves an excellent exterior coating for acid cooling coils since it has practically no insulating effect. It can also be used for protection of structural iron and steel, ducts and piping and a variety of industrial machinery.—Enjay Maintenance Engineers, 327 Union Ave., Rutherford, N. J.

Resin Raw Material

Is similar to urea; properties of its resins fall between those of urea and melamine.

Biuret, $H_2NCONHCOHNH_2$, is a new urea-like material that's available in experimental quantities for evaluation by resin manufacturers. It generally follows the use pattern of urea in that resins for adhesives, textile and paper treating, molding powders and coatings are expected to be made from it.

In addition, certain blowing agents can be derived from biuret. Preliminary work indicates that its resins are superior to those of urea, but inferior to melamine resins. The material is not expected to replace either urea or melamine, but rather to compete with both of them.

Actually, crystalline biuret is made from urea in the same way that you could—but don't—make melamine from urea. If and when the product is put out in tonnage quantities, it is expected to have a price tag of 10c./lb. (based on urea at 6c./lb.). In smaller batches, the price could go as high as 20c./lb.

Biuret hydrolyzes in hot water, although less readily than urea, and also forms a highly colored copper complex which is useful for analysis. Its melting point is 192.5-193 deg. C. (with decomposition).—Nitrogen Div., Allied Chemical & Dye Corp., New York 6, N. Y.

New Phenolic Resins

These overcome most of the inherent limitations of phenolics for use in protective coatings.

A new line of phenolic resins based on R-108 chemistry has been introduced by GE. Known as 75120 and 75121 Methylon resins, they impart outstanding chemical resistance to protective coatings.

This new family of coating intermediates and resins is said to have a wide range of compatibility with resins commonly used in finishing plants. Most of the inherent limitations of phenolics used in protective coatings have been overcome without sacrificing any of the useful properties.

The resins, although they are film-forming in themselves, are not finished

coatings in the generally accepted sense. Rather, they are converted into a wide variety of finishes that are highly resistant to corrosive and oxidizing agents.

Potential uses include container linings for drums, primers requiring special resistance properties and industrial coatings for chemical processing equipment. Since the finishes are free from the tendency of conventional phenolic coatings to crater, they can be applied more easily and quickly.—General Electric Co., Chemical Div., Pittsfield, Mass.

Pre-Processed Resins

Highly purified and analyzed so as to eliminate the resin as a process variable.

Ion exchange resins are now being pre-processed to make them suitable for chemical, medical and physical laboratory application. Designed to provide a source of pure, ready-to-use resins with known properties, they will allow standardized, reproducible procedures to be carried out even at different locations, since the resins will be eliminated as an experimental variable.

Dowex starting material, supplied by Dow Chemical, is being more completely sized, purified by alternate acid, base and organic-solvent cycles and defined—by individual batch analysis covering moisture content, cross linkage, capacity, size distribution and porosity.

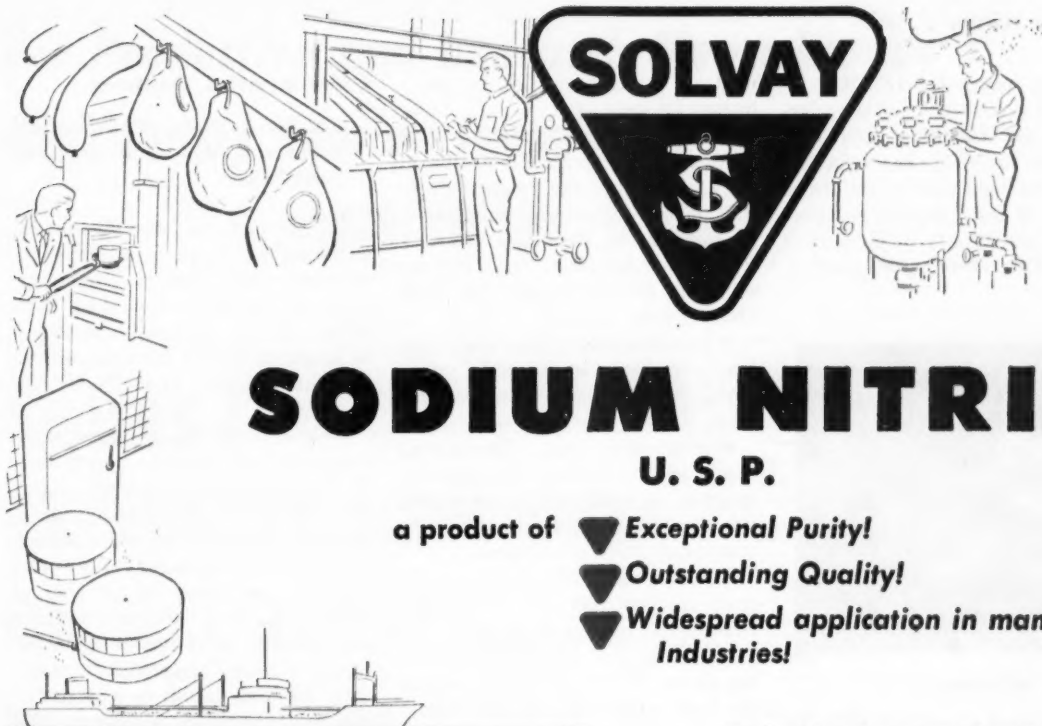
Resins presently available from stock include four types processed from Dowex 50 (cation exchange), and Dowex 1, 2 and 3 (anion exchange). Other special resins will be made available as required.—Bio-Rad Laboratories, 800 Delaware St., Berkeley 9, Calif.

Plastielzers

Give low-temperature flexibility to polyvinyl chloride resins.

Two new low-temperature plastielzers for polyvinyl chloride resins are now commercially available. They are di (2-ethylhexyl) adipate—DOA—and di-n-octyl, n-decyl phthalate—DNODP.

DOA imparts excellent low temperature flexibility, heat and light stability and is useful for controlling



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DO YOU HAVE A CORROSION PROBLEM?

SOLVAY Sodium Nitrite is an excellent anti-corrosion agent that will not injure the skin of a normal person. It will however protect a wide variety of metals including iron and steel.

Among the current applications utilizing this property of SOLVAY Sodium Nitrite are: prevention of corrosion in air conditioning units and circulating water systems; as a corrosion inhibitor in water base paints, water soluble hydraulic fluids, metal cutting and grinding compounds; as a rust preventive in household scouring pads and radiator anti-freeze compounds.

Quantities of 1/10 of 1% or less have given complete protection against corrosion!

Physical and Chemical Properties:

Molecular Weight: 69.01.

Solubility: In water: 20% at -12° C., 39% at -26° F. (eutectic). 50% at 42° C., 60% at 90° C. SOLVAY Sodium Nitrite is slightly soluble in alcohols, very soluble in anhydrous ammonia. It is endothermic—it has a negative heat of solution.

Melting Point: 271° C., decomposes at 320° C.

Appearance: Crystalline, slight yellow cast, almost 100% will pass through a No. 20 screen.

Reactions: Can be either a reducing or oxidizing agent. Provides NO₂ for azo reaction.

Quality: U.S.P. grade. Better than 99% NaNO₂, very low in chlorides and metallic impurities.

Toxicity: SOLVAY U.S.P. Sodium Nitrite is not a poison as defined in the manual of the M.C.A. It is toxic to humans when taken internally in quantity. It is non-irritating to normal human skin.

A Few Uses of SOLVAY Sodium Nitrite

METAL INDUSTRY

- for corrosion prevention
- for oxidizing compounds
- for heat treating salts
- for specialized metal cleaning compounds
- for enameling
- for detinning

MEAT PACKING

- as a color fixative for meats

TEXTILE INDUSTRY

- in azo dyeing

ORGANIC CHEMICAL SYNTHESIS

- as a reagent in organic synthesis
- provides nitrite ion for diazonium reduction

Performing Important Functions in American Industry!

SOLVAY Sodium Nitrite meets the highest standards of *purity* and *quality*! Because of its physical and chemical characteristics, this versatile product is now being used to do a variety of essential jobs in a great many industries.

What Can SOLVAY Sodium Nitrite Do For You?

If you have a process in which SOLVAY Sodium Nitrite is being used or can be used, may we offer SOLVAY's Technical Service to assist you in its application to your situation. You can send us in complete confidence a description of your product or the process involved.

New Test Kit Now Available!

SOLVAY has prepared an inexpensive kit for testing low strength sodium nitrite solutions used in corrosion control. Write for complete information and price.

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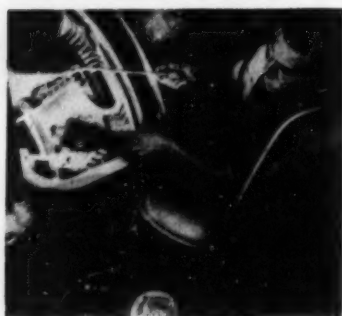
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viscosity of plastisols. DNODP is said to be the most economical quality plasticizer for obtaining good low-temperature flexibility, low volatility, good heat and light stability and water resistance. It, too, imparts excellent viscosity characteristics to plastisols.—Monsanto Chemical Co., St. Louis 4, Mo.



Safety Solvent

Formulated to replace carbon tetrachloride in all solvent cleaning operations.

Turco-Solv, an effective, quick-drying safety solvent, is designed for cleaning electrical equipment such as wiring, fuses and motors. It is a combination of the least toxic solvents available, consistent with safety from fire hazards.

Typical uses include removing grease pencil, ink or hand marks from motor generators on a production line and in-plant maintenance cleaning where a high-flash material is needed (Tag Closed Cup flash point over 200 deg. F.).

The solvent leaves no oily residues, requires no neutralization. It is non-corrosive and safe for use on metal, wood and wood-bonded paint surfaces. Since it is nonconductive, Turco-Solv can be used to clean hot motors.—Turco Products, Inc., Los Angeles 1, Calif.

Textile Water Repellent

Recommended for wool, acetate, nylon, acrylic and polyester fibers; easy to apply.

Fresh from success in Europe, DuPont's water soluble Quilon—stearato chromic chloride—is now being marketed in the U. S. as a water repellent for textiles. The product has been

used in a similar service by paper treaters for some years.

Woolen suits and topcoats made water repellent by Quilon caught on quickly in France and Belgium where the inhabitants seem to be more prone to continue on their way during a storm than Americans are. Here are some of the advantages Du Pont claims for the product:

- Quilon-treated Fiber glass curtains and drapes are washable, quick-drying and resistant to water-borne stains.

- Orlon-wool and Dacron-wool blends have their water-absorption reduced by as much as 75 percent with this treatment. Also, resistance to water penetration is increased.

- Both wool and fur felts are made water resistant, yet can still be dry cleaned.

Very little Quilon is needed in treating fabrics. Wool and blends containing high percentages of wool require 1.5-2 percent retention by weight. Most synthetic fibers need about half that much. Drying temperatures should be above 212 deg. F., but no additional heat curing is needed.—E. I. du Pont de Nemours & Co., Inc., Grasselli Chemicals Dept., Wilmington 98, Del.

Product Briefs

Methoxyethyl thioglycolate, an ester recommended for making substituted amides of thioglycolic acid or for synthetic steps requiring alcoholysis, is now available for evaluation. It boils at 112-113 deg. C. at 23 mm.—Evans Chemetics, Inc., 250 E. 43rd St., New York 17, N. Y.

Indelible colored inks, believed to be the first that will withstand the solutions and temperatures of modern industrial processes, have been announced. They are designed for identifying fabrics, paper, metals and plastics.—Driflo Manufacturing Co., Hazel Park, Mich.

α -Methylstyrene dimers, a new product for modifying polymerization reactions, is suggested as a nonsticking agent in the annealing of metal products. It is readily soluble in acetone, benzene, carbon tetrachloride and similar solvents.—Dow Chemical Co., Midland, Mich.

Unsaturated Amines

Should be useful in lubricant additives, corrosion inhibitors and emulsifiers.

For the first time, two unsaturated secondary amines are being offered to industry. Called Armeen 2S and Armeen 2T, the products are made from tallow and soya and can be purchased in single drum lots for experimental use. Prices are 43c./lb. for 2S, 40c./lb. for 2T.

Because of their unsaturation, these compounds are easier to liquefy than the corresponding saturated amines and show better solubility in organic solvents. Extensive use evaluation has not yet been undertaken, but the usual reactivity and polar substantivity of amines and their derivatives indicate incorporation in corrosion inhibitors, textile treating compounds, emulsifiers, lubricant additives and rubber processing chemicals. Average analyses are shown below.—Armour & Co., Chemical Div., Chicago 9, Ill.

Analysis of Armeens

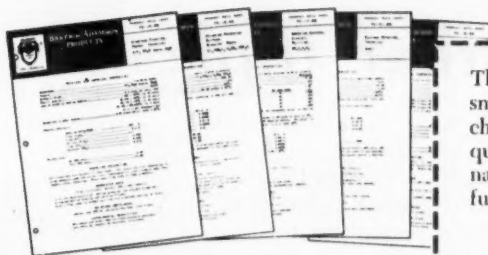
	Armeen 2S	Armeen 2T
Secondary amine content	85%	88%
Primary amine content	5%	5%
Neutralisation equivalent	520-540	520-40
Iodine value	60 min	35 min.
Temperature to liquefy	45-50°C.	50-55°C.
Color	light tan	Light tan

A new development of Buna N, Compound 1225, has good heat resistance, good oil resistance and low compression set at high temperatures (300-325 deg. F.). Also, it's flexible as low as -40 deg. F.—Goshen Rubber Co., Goshen, Ind.

Two resin emulsion tackifiers, Arccos 25 and 26, designed to break fast-breaking emulsion adhesives, develop fast-breaking properties without loss of emulsion stability. First use will be with natural and synthetic rubbers.—American Resinous Chemicals Corp., Peabody, Mass.

Two new channel carbon blacks, Elf 75 and Elf 75 Densed are on the market. The extra volatile content of Elf 75 gives increased flow and greater flexibility in formulations. The increased density of Elf 75 Densed results in lower shipping costs and reduced storage space needs.—Godfrey L. Cabot, Inc., Boston, Mass.

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<input type="checkbox"/> Aluminum Chloride, 32° Baume Solution	DA-83851
<input type="checkbox"/> Aluminum Fluoride, Powder, Technical	DA-32521
<input type="checkbox"/> Aluminum Nitrate, Crystal, Technical	DA-32341
<input type="checkbox"/> Aluminum Sulfate, Hexahydrate, Technical	DA-48871
<input type="checkbox"/> Ammonium Acetate, Crystal, Purified	DA-32711
<input type="checkbox"/> Ammonium Fluoborate, Crystal, Technical	DA-32731
<input type="checkbox"/> Ammonium Fluoride, Crystal, Technical	DA-32471
<input type="checkbox"/> Ammonium Oxalate	DA-32351
<input type="checkbox"/> Ammonium Sulfate, Purified	DA-33151
<input type="checkbox"/> Ammonium Thiosulfate, Solution, Technical	DA-85271
<input type="checkbox"/> Barium Fluoride, Technical	DA-34181
<input type="checkbox"/> Calcium Acetate, Powder, Purified	DA-34991
<input type="checkbox"/> Calcium Chloride, Anhydrous, Purified	DA-49211
<input type="checkbox"/> Calcium Chloride, USP	DA-35011
<input type="checkbox"/> Calcium Fluoride, Powder, Reagent	DA-35201
<input type="checkbox"/> Calcium Phosphide, Technical	DA-35341
<input type="checkbox"/> Chromium Fluoride, Technical	DA-35771
<input type="checkbox"/> Chromium Potassium Fluoride, Purified	DA-35791
<input type="checkbox"/> Chromium Potassium Sulfate, Granular, Photo	DA-35841
<input type="checkbox"/> Cupric Fluoride, Technical	DA-36481
<input type="checkbox"/> Cuprous Chloride, Technical	DA-36571
<input type="checkbox"/> Ferric Nitrate, Crystal, Technical	DA-37441
<input type="checkbox"/> Ferrous Ammonium Sulfate, Crystal, Technical	DA-37571
<input type="checkbox"/> Lead Nitrate, Crystal, Technical	DA-38371
<input type="checkbox"/> Magnesium Fluoride, Purified	DA-39121
<input type="checkbox"/> Oxamide, Purified	DA-48651
<input type="checkbox"/> Potassium Acetate, N. F., & Crystal, Technical	DA-40821
<input type="checkbox"/> Potassium Bifluoride, Technical	DA-41461
<input type="checkbox"/> Potassium Borate, Tetra, Purified	DA-40771
<input type="checkbox"/> Potassium Cyanate, Powder, Purified	DA-41591
<input type="checkbox"/> Potassium Cyanate, Powder, Technical	DA-48821
<input type="checkbox"/> Potassium Fluoborate, Crystal, Technical	DA-41361
<input type="checkbox"/> Potassium Fluoride, Anhydrous, Purified	DA-40911
<input type="checkbox"/> Potassium Fluoride, Crystal, Purified	DA-41041
<input type="checkbox"/> Potassium Nitrate, Fused, Lump	DA-85521
<input type="checkbox"/> Potassium Titanium Fluoride	QA-40721
<input type="checkbox"/> Sodium Fluoborate, Crystal, Technical	DA-42401
<input type="checkbox"/> Stannous Chloride, Crystal, Technical	DA-43421
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"Tube up and forget it" with leakproof Parker Triple-lok Fittings

Cramped and crowded, nobody likes to do this kind of a job over again. That's why trouble-free Parker *Triple-lok* fittings were used. Since this hydraulic test stand was completed, it has run over a billion impulse cycles at 3000 psi. without a single leak at any *Triple-lok* fitting.

These flare fittings are absolutely leakproof even under the severest conditions of vibration, high pressures and temperatures. Thousands of destruction tests prove that they will hold pressures that burst the tubing. And, they remain leakproof no matter how often you reassemble them!

Using *Triple-lok* fittings is also the easiest and fastest way to tube up your system even in close quarters. Flared tubing simplifies installation. For fitting make-up, you need only a small wrench because assembly torque is so low.

These fittings meet J.I.C. and S.A.E. standards plus specifications of the A.S.M.E. Code for Pressure Piping.

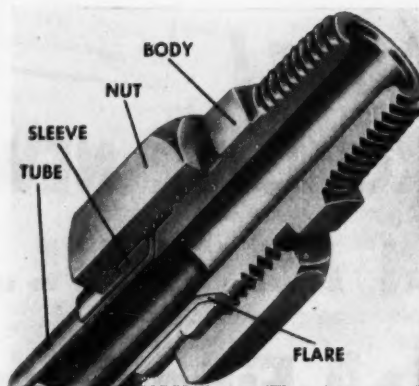
As a matter of fact, *Triple-lok* is the standard of industry. More *Triple-lok* fittings are used on industrial machinery than any other fitting.

So, tube up and forget it. Use *Triple-lok* throughout your plant. Parker offers the widest range of shapes and sizes available . . . for tubing outside diameters from 1/8 through 2 inches. Ask your distributor for Catalog No. 4300.

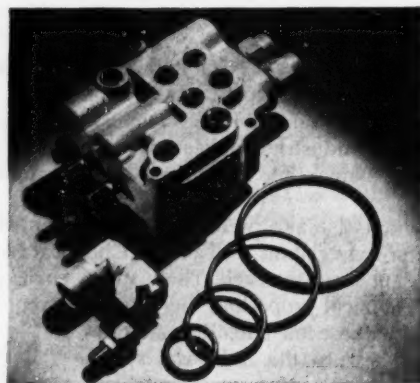
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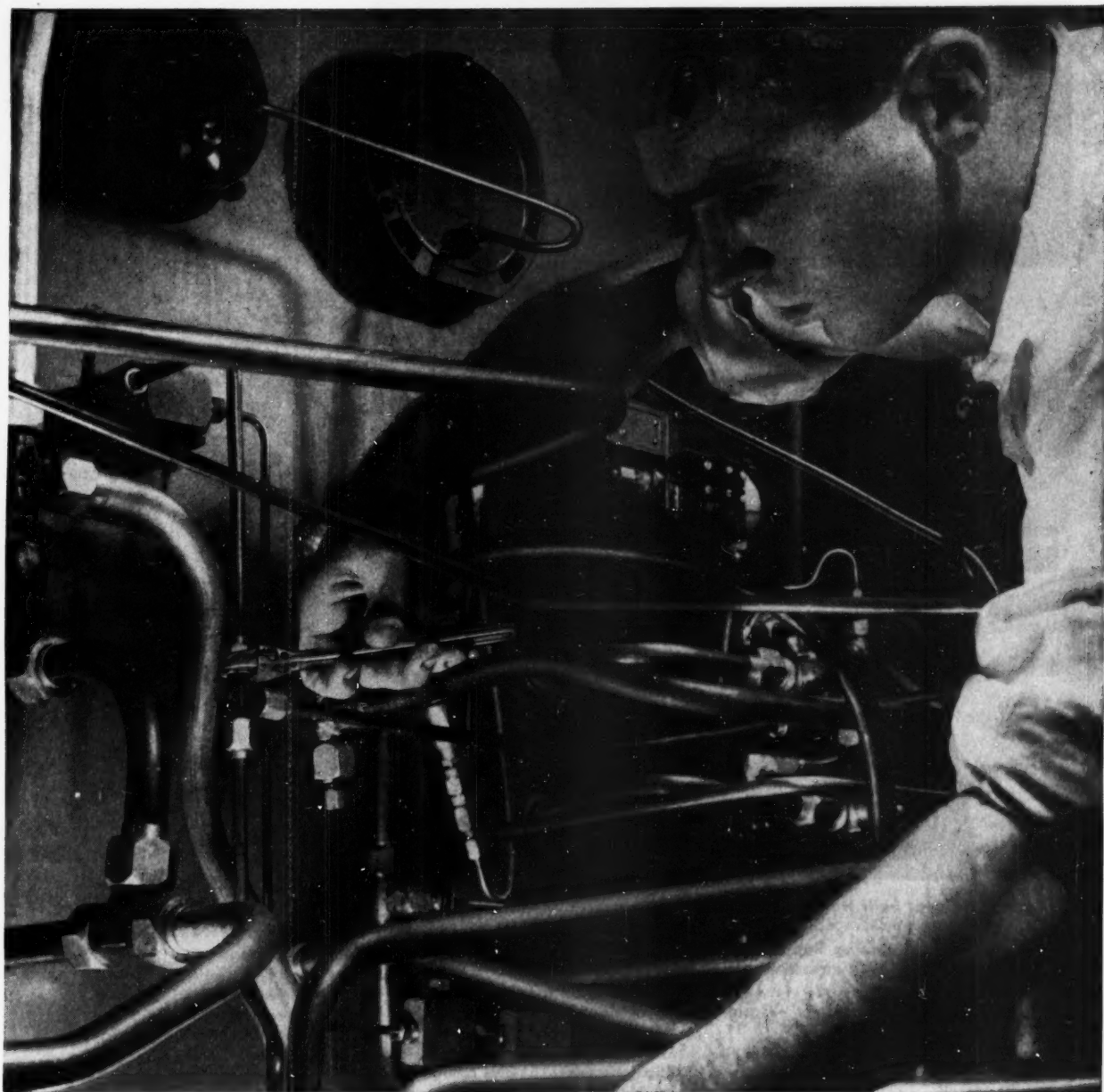
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Harrison, N. J. Whitehead Metal Products Co.
1000 South Fourth Ave.
Houston 3, Tex. Metal Goods Corp.
711 Milby St.
Houston 1, Tex. Standard Brass & Mfg. Co.
2018 Franklin St.
Indianapolis, Ind. Avels Sales & Engineering Co.
16 W. 22nd St.



Easiest way to install tubing, even in cramped quarters, is to use Parker Triple-lok flare fittings. Assembly torque is so low that you need only a small wrench for fitting

make-up. The self-aligning sleeve acts as a lock washer, supports the tube, and damps vibration. Triple-lok is absolutely leakproof even under high pressures and temperatures.

Jacksonville, Fla. Florida Metals, Inc.
2937 Strickland St.
Kansas City 18, Mo. Metal Goods Corp.
1300 Burlington Ave.
Knoxville 5, Tenn. Leinart Engineering Co.
412 E. 5th Ave.
Los Angeles, Cal. Haskell Engineering & Supply
1236 S. Central Ave., Glendale 4
Los Angeles 12, Cal. Metropolitan Supply Co.
353 E. 2nd St.
Memphis, Tenn. J. E. Dilworth Co.
730 South Third St.
Miami, Fla. Florida Metals, Inc.
4100 N. W. 37th Ct. Hialeah
Milwaukee 3, Wis. Morman Belting & Supply Co.
522 W. State St.
Milwaukee 4, Wis. Wallace Companies of Wisconsin, Inc.
838 South 6th St.
Minneapolis 16, Minn. Vincent Brass & Copper Co.
124 Twelfth Ave. South
New Orleans 12, La. Metal Goods Corp.
432 Julia St.

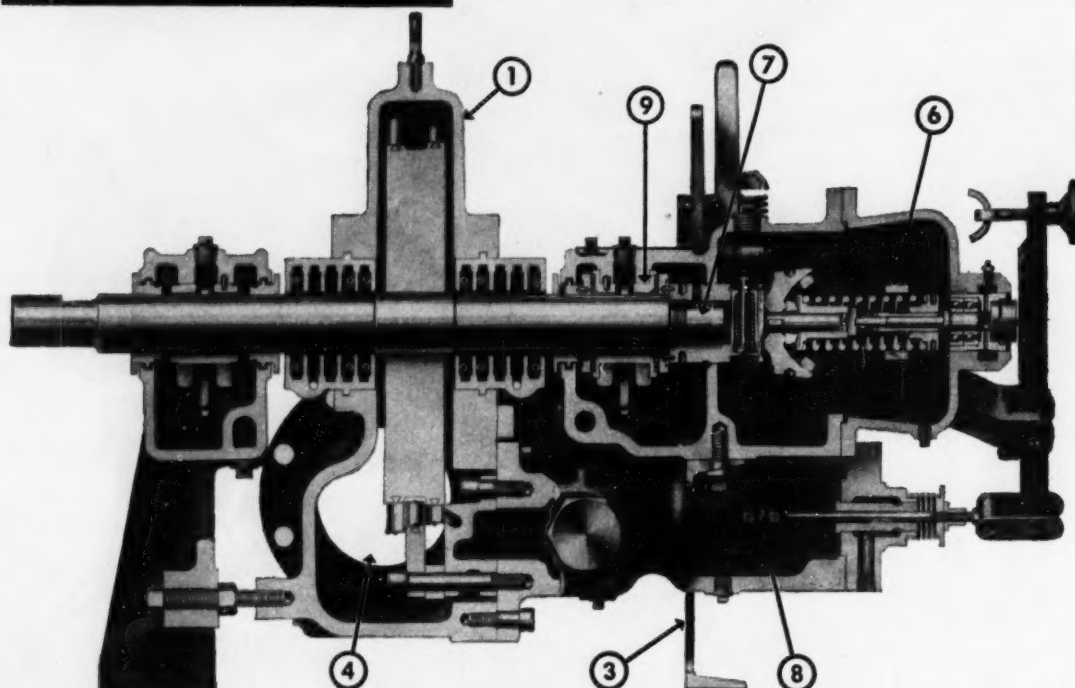
Newport News, Va. Noland Company
27th St. & Virginia Ave.
New York, N. Y. Nielsen Hydraulic Equipment, Inc.
5 Penn Place, Pelham Manor 65
New York 14, N. Y. Whitehead Metal Products Co.
303 W. 10th St.
Odessa, Tex. Snyder Co., Inc.
2604 Kermit Highway
Philadelphia, Pa. Louis H. Hein Co.
15 W. Lancaster Ave., Ardmore
Philadelphia 40, Pa. Whitehead Metal Products Co.
1955 Hunting Park Ave.
Pittsburgh 33, Pa. Williams & Co.
901 Pennsylvania Ave.
Portland 10, Ore. Hydraulic Power Equipment Co.
2316 N. W. Savier St.
Roanoke 10, Va. Noland Company
1226 Center Ave. N. W.
Rockford, Ill. Rockford Tool & Transmission Co.
802 Broadway
Salt Lake City 4, Utah Pace-Turpin & Co.
726 South Third West

San Francisco 3, Cal. General Machinery & Supply Co.
1346 Folsom St.
Seattle 9, Wash. Palmer Supply Co.
222 Westlake North
Shreveport, La. Standard Brass & Mfg. Co.
1557 Texas Ave.
St. Louis 15, Mo. Metal Goods Corp.
5239 Brown Ave.
Syracuse 4, N. Y. Whitehead Metal Products Co.
207 W. Taylor St.
Tampa, Fla. Florida Metals, Inc.
222 N. 12th St.
Toledo 2, Ohio Williams & Co.
650 E. Woodruff Ave.
Tulsa, Okla. Arden Supply Co.
303 S. Frankfort
Tulsa 3, Okla. Metal Goods Corp.
302 N. Boston
Export Mercator Corp.
438 Walnut St., Reading, Pa., U.S.A.
Canada Railway & Power Engineering Corp., Ltd.

NEW DE LAVAL HCB

SINGLE STAGE TURBINE

can be ordered from stock



1 Case and Cover Split Horizontally on centerline for ease of maintenance.

2 True Centerline Casing Support assures distortion-free radial expansion. Not shown.

3 Flexible Support at governor end provides for axial expansion.

4 Exhaust Opening either right or left side for installation flexibility.

5 Steam Strainer, protecting trip and governor valves, is removable for cleaning without

breaking steam connections. Not shown.

6 Constant Speed Governor features governor weights pivoted around frictionless surfaces.

7 Complete Governor Assembly is now replaceable as a unit.

8 Balanced Single Seated Main Governor Valve has proportional flow characteristics for sensitive, positive control.

9 Shaft Locating Bearing of adjustable double collar type.

Horsepower: 100 MAX
Steam Pressure: 300 PSIG MAX
Steam Temperature: 550F MAX
Exhaust Pressure: 25 PSIG MAX
Speed: 4,000 RPM MAX
Steam Inlet: 2"-250# ASA FLG.
Exhaust: 6"-150# ASA FLG.
Weight: 1,200 LB.

Here's the new De Laval HCB Single Stage Turbine which is now "on the shelf" . . . ready for immediate shipment. This mechanical drive turbine is simple, rugged, designed for long economical life and low maintenance. For example, note the true centerline casing support, the replaceable governor, the remova-

ble steam strainer. Investigate all the advantages of this versatile driver. It is ready to handle—at low cost—a variety of applications in your plant.

*Send for new Bulletin 4206
which gives vital facts and figures*



DE LAVAL Mechanical Drive Turbines

DE LAVAL STEAM TURBINE COMPANY

803 Nottingham Way, Trenton 2, New Jersey

CLC09

160

February 1954—CHEMICAL ENGINEERING

**TAKES THE BLOW OFF...
CUSHIONS SHOCK**

PENFLEX TUBING

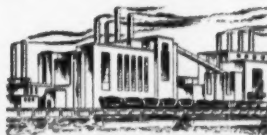
ABSORBS THERMAL EXPANSION... PREVENTS BLOW-OUT

WHEN SAFETY VALVES pop in this large industrial plant, a terrific surge of 900°F. steam blasts through the blow-off pipes under as much as 850 psi pressure. Ordinary pipe would blow apart. But Penflex Flexible Metallic Tubing has enough "give" to take the shock. Six lengths of 8" Penflex interlocked tubing cushion the sudden impact . . . take up any pipe movement due to extreme temperature and pressure changes.

The Penflex Engineer can help you solve your tough tubing problems. A complete line of Penflex Flexible Metallic Tubing, Hose, and Couplings is at your disposal—4-wall interlocked and seamless welded corrugated tubing and metallic hose from 1/8" to 24" I.D. . . . automatic barrel fillers, pneumatic rivet passers, and fittings. Write for the new illustrated data book, "Flexineering."

Pennsylvania Flexible Metallic Tubing Company, Inc.
7234 Powers Lane, Phila. 42, Pa.

Offices: Boston • New York • Chicago • Houston • Cleveland • Los Angeles

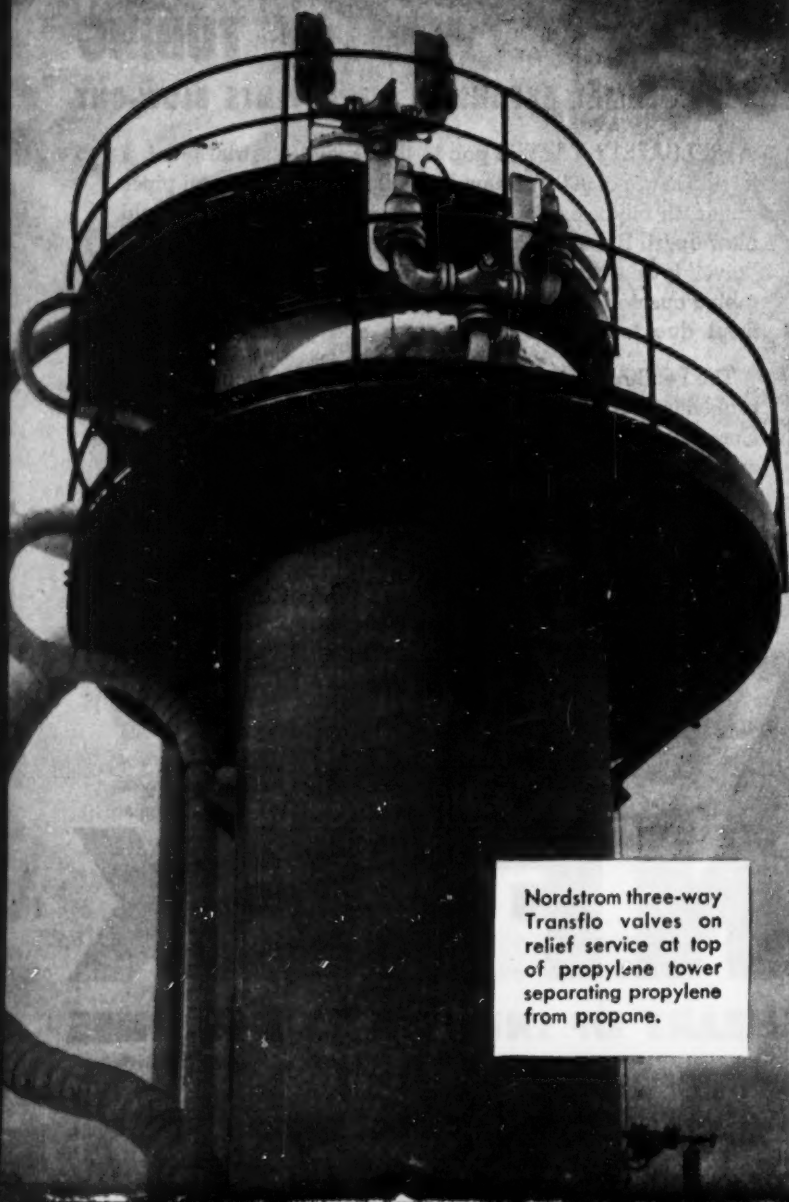


PENFLEX

HEART OF INDUSTRY'S LIFE LINES

THESE TWO EXAMPLES SHOW YOU

What Nordstrom Means by "Lubricant"



Nordstrom three-way Transflo valves on relief service at top of propylene tower separating propylene from propane.

TYPICAL NORDSTROM REFINERY APPLICATIONS

Catalytic Polymerization	Thermal Cracking
Crude Topping and Vacuum Distillation	Phenol Extraction
Fluid Catalytic Cracking and Gas Recovery	Propane Deasphalting
Distillate Recovery in Cycling Plants	Cycloversion
Duo-Sol Solvent Extraction	Delayed Coking
Houdrifiow Catalytic Cracking and Gas Recovery	Girbotol Process
Light Ends Fractionating	Propane Dewaxing
	Hydroforming Process
	Naphtha Polyforming
	Solexol Process
	Solvent Dewaxing
	Thermal Reforming

Nordstrom has compiled a series of specification sheets for each of these processes, showing recommended materials, pressure classes, lubricants and valve figure numbers. Ask your Nordstrom sales engineer to review them with you.

TYPICAL NORDSTROM PROCESS INDUSTRY APPLICATIONS

Beverage Plants	Rubber Plants
Cement Plants	Sewage Plants
Chemical Plants	Smelters and Mines
Explosives	Soap Factories
Food Plants	Steel Mills
Gas Plants	Sugar Refineries
Ice and Refrigeration	Synthetic Ammonia
Paint and Lacquer	Synthetic Fibers
Paper and Pulp	Synthetic Plastics
Pharmaceuticals	Synthetic Rubber
Power and Steam Plants	Tanneries
	Textiles and Dyes
	Water Works

The new Nordstrom Corrosion-Resistant Valve Bulletin V-217 will make it easy for you to fit the right valve to each service. Write for a copy, Rockwell Manufacturing Company, Pittsburgh 8, Pa., or ask your Nordstrom sales engineer.

-Sealed for POSITIVE SHUT-OFF"

Here are two typical Nordstrom valve process applications—one is a propylene tower, the other a dry hydrogen line.

They illustrate an important point in specifying valves for process service . . . if really tight shut-off of hard-to-hold gases or fluids is important, no valve can do the job better than Nordstrom.

Why? Because Nordstrom is the original lubricated plug valve. Nordstrom is the valve with the extra seal of plastic lubricant around the valve ports to check seepage of even the lightest, most penetrating substances.

That, of course, means greater safety, and greater economy, too, because when leakage is prevented, valve life is far longer. And most important, it means uninterrupted operation of continuous process units—no down-time for avoidable valve repairs.

The same lubricant that seals, also keeps the valve ready to operate in an emergency.

Nordstrom valves are built in a wide range of sizes, pressures, special metals and body designs for the process industries, including three- and four-way designs for batching, blending and switching. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Canadian License: Peacock Brothers Limited

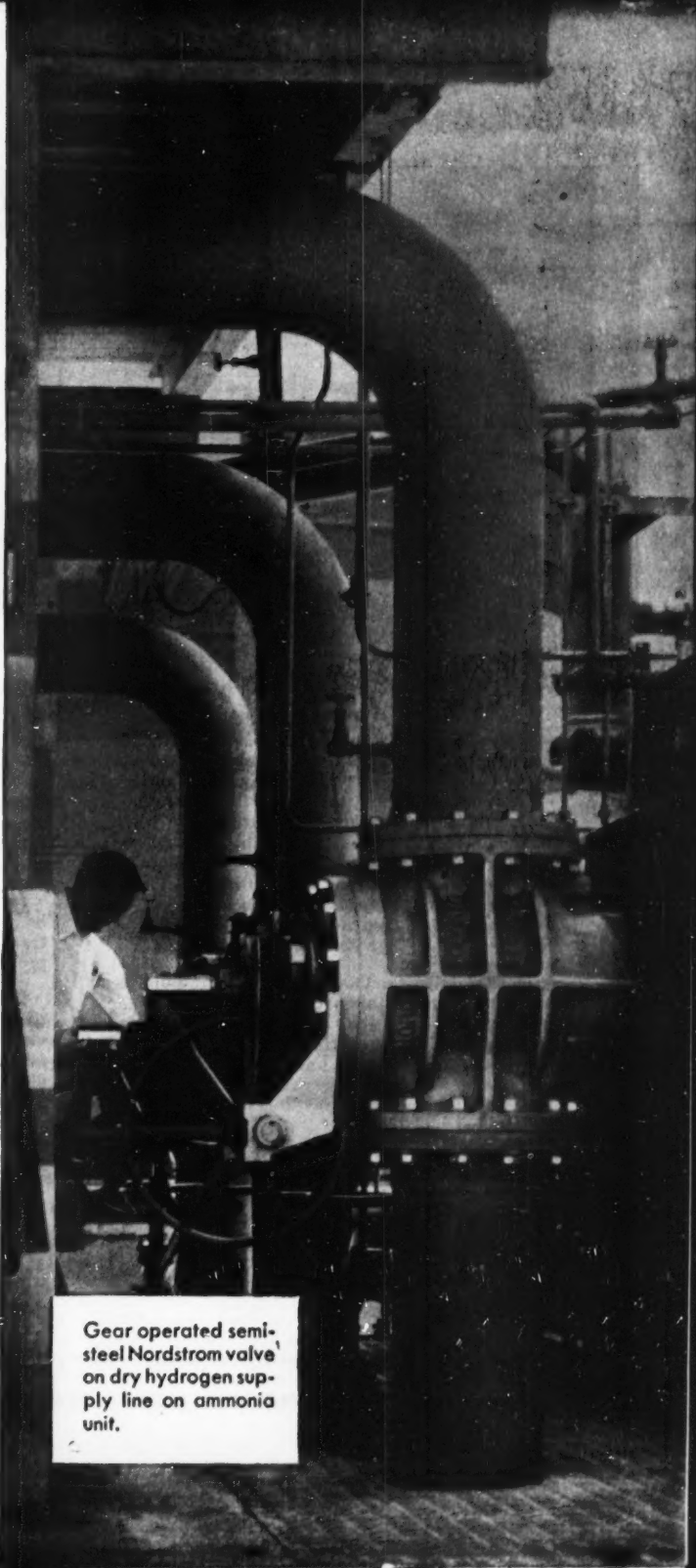
ROCKWELL Built Nordstrom Valves

Lubricant-Sealed for Positive Shut-Off

Another

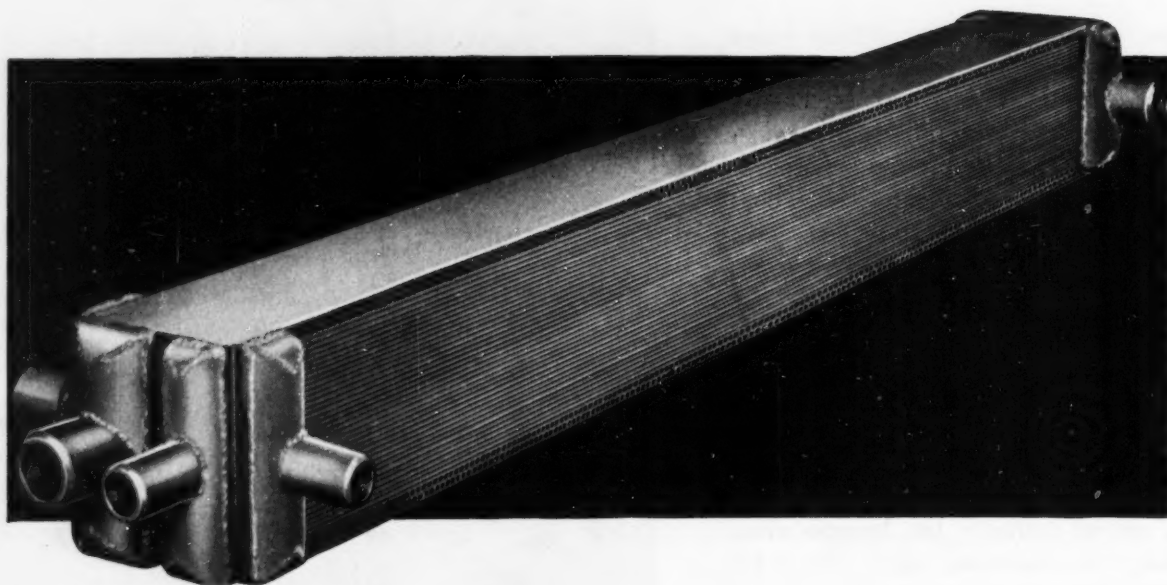


Product



Gear operated semi-steel Nordstrom valve on dry hydrogen supply line on ammonia unit.

How to take the plus cost out of minus temperatures even at -350°



In many applications, TRANE Brazed Aluminum Heat Exchangers have licked the problem of excessive cost in low temperature heat transfer. Fabricated entirely of aluminum, they take full advantage of aluminum's higher thermal conductivity, its improved strength and high ductility at low temperatures. This, plus the inherently higher performance characteristics of the TRANE Brazed Aluminum Surface design, produces a heat exchange unit that is lighter, more compact, far more efficient—and far less costly—than conventional equipment.

In many instances, TRANE Brazed Aluminum Heat Exchangers have taken only *one-third* the space, weighed only *one-fourth* as much, as conventional exchangers. Yet, for all their light weight and compactness, these rugged units have the ability to operate at working pressures up to 450 lbs. p.s.i. at lowest temperatures.

Because of their economy, and because of their

ability to operate dependably at temperatures as low as -350 degrees and still pack as much as 450 square feet of surface into a single cubic foot of lightweight space, TRANE Brazed Aluminum Surfaces are ideally suited for low temperature applications such as ammonia, oxygen, helium, nitrogen and argon processing.

For that matter, TRANE Brazed Aluminum should be your first consideration for any difficult heat transfer application requiring *close temperature approaches, multi-stream exchange, or low temperatures.*

If you have a heat transfer problem, now is the time to call in TRANE. Our 30 years' experience in various types of heat transfer, and our engineering facilities, are always at your disposal. And for your files, get your copy of "Extended Surface Heat Transfer Equipment," showing the wide range of design possibilities. Simply contact your nearest TRANE Sales Office or write to TRANE, La Crosse, Wis.

TRANE brazed aluminum heat transfer surfaces

The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn. • Trane Co. of Canada, Ltd., Toronto • 87 U.S. and 14 Canadian Offices.

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

You Get More Use per Dollar

with Homoflex Hose

For air, water, other fluids and gases Homoflex Hose is easier to handle because it has no pre-set twist, coils and uncoils easily with no kinking, is light in weight, yet strong, and "Flexible as a Rope."

R/M Hose Engineering makes possible high flexibility . . . homogeneous cover, strength member and tube that are inseparable.

Homoflex Hose gives you

"More Use per Dollar" two ways . . .
men do more work with it . . .
and it lasts longer.

Ask the R/M Distributor for Bulletin 6879 . . .

and, don't forget, there's equally good
"More Use per Dollar" engineering in
All other types of R/M hose, conveyor belts,
V-belts and flat transmission belts.



MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

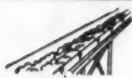
RAYBESTOS-MANHATTAN, INC.



Flat Belts



V-Belts



Conveyor Belts



Hose



Roll Covering



Tank Lining



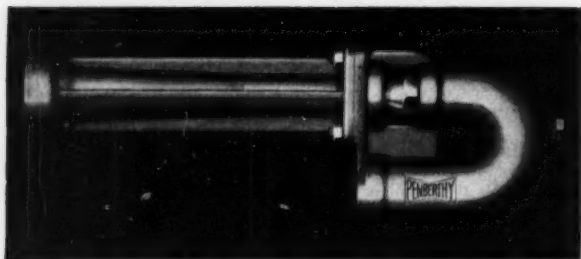
Abrasive Wheels

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

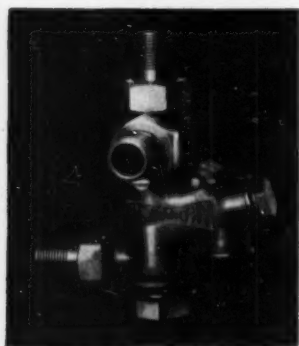
RM 408

*There's Certain
satisfaction
in PRODUCTS BY*

PENBERTHY



JET PUMPS—Penberthy can help you put the simple, economical principles of the jet pump to work wherever it's necessary to transfer or mix any liquid which will flow through a pipe. We make a complete line and have years of engineering experience upon which you can depend.



AUTOMATIC INJECTORS

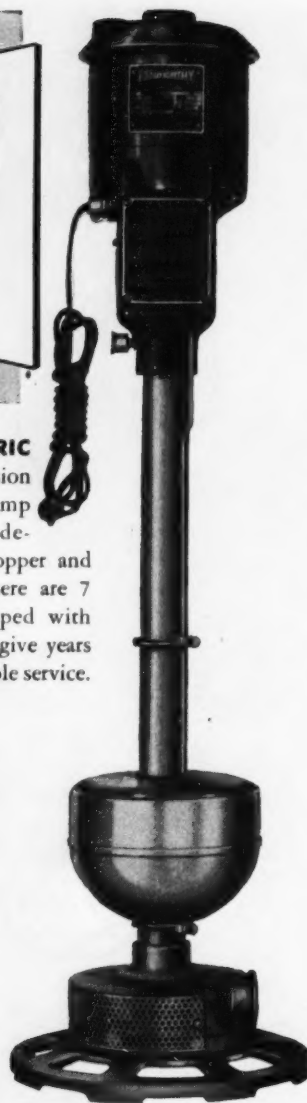
Penberthy injectors are the accepted method of assuring a dependable supply of feed water, at lowest cost, to oil field and other firebox and portable boilers. They are being used increasingly for standby service on many large boilers. Easily installed, they require little or no attention.

AUTOMATIC CELLAR DRAINERS • WATER HEATERS EJECTORS • HYDRAULIC EJECTORS • EDUCTORS EXHAUSTERS • CYCLING JET PUMPS • SYPHONS

...are among the other Products by Penberthy which can serve you in your operation. Why not write for literature detailing specifications and advantages. Ask, too, about the engineering service which Penberthy is providing for many prominent concerns in your industry.

AUTOMATIC ELECTRIC SUMP PUMPS

Corrosion resistant Penberthy sump pumps are correctly designed and made of copper and bronze throughout. There are 7 sizes, 3 models equipped with trouble-free features to give years of economical, dependable service.



LIQUID LEVEL GAGES—Penberthy makes a complete line of gages and valves for every type of application. 70 years of engineering experience is on hand to accommodate your particular requirements. You can always be assured of complete cooperation and reliable product service for any pressure...in any length.

Established 1886

**PENBERTHY
INJECTOR COMPANY**

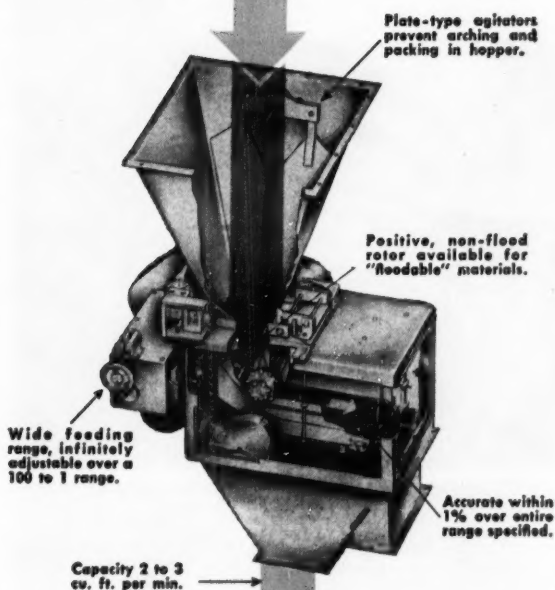
Division of the Buffalo-Eclipse Corporation
1251 Holden Avenue, Detroit 2, Michigan

Manufacturers of Quality Products Since 1886

PUSH BUTTON CONTROL . . .



for *Continuous* compounding of dry materials



This six-feeder production line, built for one of the country's leading processors of fertilizers, is designed for complete push button control from a central control panel. The OMEGA BELT GRAVIMETRIC FEEDERS (Models 44-20A and 50-8) used in this system continuously weigh and feed superphosphate, potash, and other chemicals at a high production rate. Each feeder is totally enclosed, dust-tight, and built for continuous, accurate operation.

Flexibility, the keynote of the system, is shown by the pin-point control of all equipment from the central control panel. Proper components are selected for each formula, individual feed rates are adjusted by a simple handwheel, and automatic on-off lights show at a glance which feeders are operating. Auto-stop alarm devices prevent improper compounding, and chart recorders tell the overall story of chemicals fed in tons per day.

Find out for yourself how OMEGA continuous process equipment will boost your production and your business . . .

Send Coupon →

OMEGA MACHINE COMPANY

369B Harris Ave., Providence 1, R. I.

☐ Send Bulletins 35-G5 and 35-F5B describing Omega Belt Gravimetric (Weighing) Feeders. ☐ Have sales engineer call.

Our process problem involves:

- ☐ Compounding dry materials.
☐ Proportioning liquids and dry materials.

Name

Company

Street

City State

OMEGA



THE LAST WORD IN FEEDERS



WILFLEY PUMPS

NEW Potash Refining Plants

Feature Both Sand and Acid Pumps by Wilfley

Wilfley pumps were chosen for new potash refining plants in Carlsbad, New Mexico...for efficient, low cost production...for continuous, economical performance without attention.

Wherever installed, these famous pumps—both Sand and Acid—consistently increase production and create substantial dollar savings in power and maintenance.

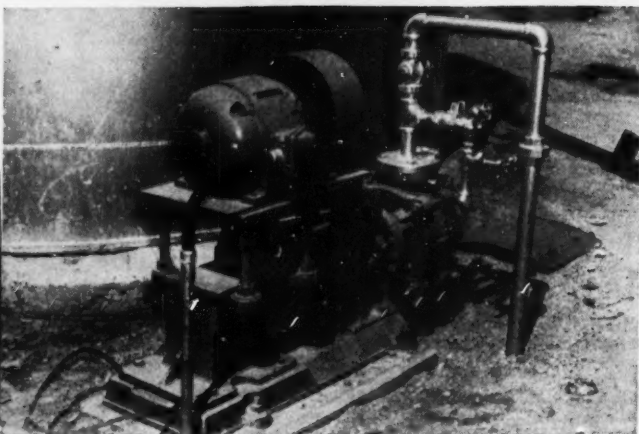
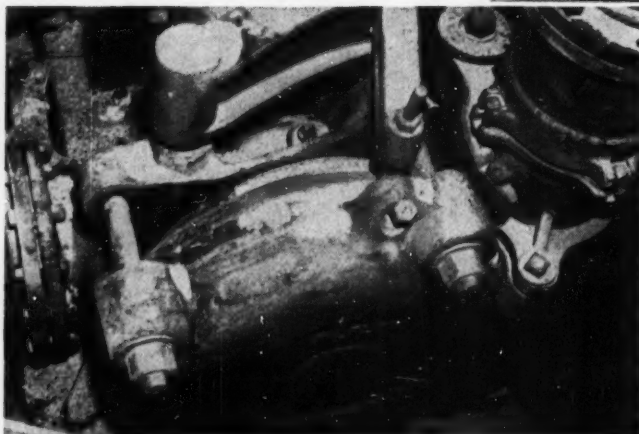
Individual engineering on every application. Write, wire, or phone for complete details.

- Cost-saving efficiency
- Stepped-up production
- Continuous operation without attention
- Minimum replacement of parts
- Designed for simple installation
- Economical pump size for every requirement

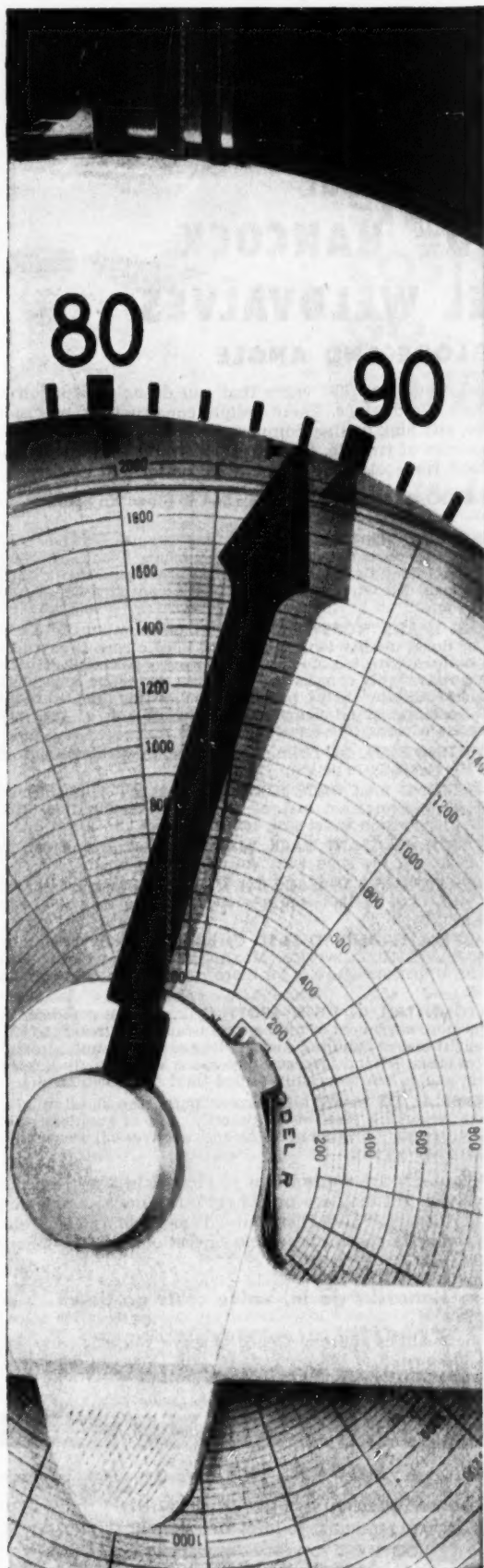
Wilfley Sand Pump

"COMPANIONS IN ECONOMICAL OPERATION"

Wilfley Acid Pump



A. R. Wilfley & Sons, Inc.
1000 Broadway, New York, N.Y.
Office: 1230 Broadway, New York, N.Y.



"We never see the red pointer!"



● That's how enthusiastic users describe performance of an L&N Pneumatic Controller—the Speedomax® round chart model. It's their way of saying a process is under strict control.

Actually, the black pointer—the real measuring index—moves along the same scale as a red one behind it, which has been preset to show the desired control point. Because L&N Pneumatic Control keeps a process so precisely, so dependably, at this matched-pointer position, the black indicator appears to "freeze" over the red. Thus at a glance—from practically anywhere in the room—the operator sees that his product is on-spec.

Pointers match to your requirements

● **Perfect "Tuning" to any Process**—Wide-range control-function adjustments include a 1 to 1000% proportional band.

● **Flexibility of Application and Operation**—Pneumatic circuit is easily adjusted for individual control conditions. Control-point setter and handy manual control knobs are mounted externally, permitting operator to make changes quickly, surely.

● **Faster Recovery from Upsets**—Recorder-controller has "lightning" response to instantly check unavoidable process upsets. Where process lags are a factor, optional use of stabilized rate action heads off process swings almost before they start. In many cases this cuts recovery time by one-third.

● **Longer On-stream Runs**—Unique "O" ring construction with tubeless assembly permits on-stream operation about 99.9% of the time.

● **Advantages of Speedomax Systems**—They can be applied in the measurement of temperature, gas analysis, electrolytic conductivity and pH.

For further information, write our nearest office, or 4916 Stenton Ave., Philadelphia 44, Pa.

LEEDS  **NORTHROP**
instruments automatic controls furnaces

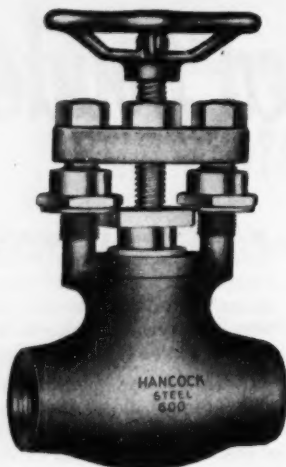
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10 FACTS YOU SHOULD KNOW

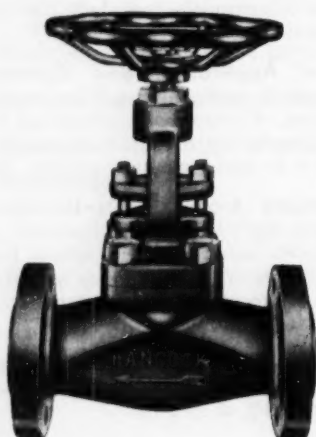
ABOUT

600# HANCOCK STEEL WELDVAlVES

GLOBE AND ANGLE



600# HANCOCK STEEL WELDVAlVES, in globe and angle types, are built for all pressures up to 850 psi at 750°F—O.W.G. 2000#, 100°F. Screwed and socket weld ends available on sizes from 1/4" through 2". Flanged ends on sizes from 1/2" through 2".



You can't buy another 600# valve that can do as good a job as these Hancock Weldvalves. Their unique construction, precision manufacture, and high quality components eliminate or neutralize all major sources of trouble. Convince yourself. Study these reasons why 600# Hancock Weldvalves serve better and longer:

- 1 BONNET JOINT ELIMINATED.** No gasket to blow. No bonnet joint to leak.
- 2 NO SEAT RING JOINT TO LEAK.** Lifetime integral seat has a 420 Brinell cobalt chromium tungsten alloy facing. Disc is 500 Brinell stainless steel. Both are accurately finished, perfectly aligned—won't leak. No wire drawing, galling, steam cutting, erosion or corrosion.
- 3 PACKING THAT'S "TOPS".** Ideal for temperatures up to 850°F. Made of finest quality long fibre yarn. Plastic core is extruded when braided wire inserted jacket is woven around it. Binder in the core is highly compressed—packing shrinkage is only 5%. Zinc dust inhibitor helps prevent stem pitting. Repacking is simple—packing gland flange can be swung out of the way, leaving both hands free to work.
- 4 NON-PITTING STEM.** 300 Brinell chrome stainless steel—not affected by electrolytic action.
- 5 NON-FREEZING BALL RACE JOINT.** Stainless steel ball bearing stem-to-disc connection assures even load distribution, easy operation, corrosion resistance, longer service.
- 6 CORROSION RESISTANT BACK SEATING.** Stuffing box can be shut off around the stem with the valve fully open.
- 7 NO NON-WORKING THREADS ON STUDS.** All studs are chromized—equivalent to 18-8 stainless steel. Non-corrosive—always workable.
- 8 BUILT EXTRA STRONG TO LAST.** Carbon steel body is suitable for 700# and 850°F. service. Maximum use of welding adds strength. Upper structure is far more rugged than conventional designs.
- 9 EASY TO INSTALL IN TIGHT SPOTS.** Space-saving compactness permits close alignment of piping with near structures. 30 to 60% less weight makes handling easier. Flanged ends simplify installation of sizes 1/2" and larger where space is extremely limited. Packing glands can be readily pulled tight in close quarters.
- 10 ECONOMICAL TO MAINTAIN.** Fewer parts, the finest quality packing, repacking ease, every practical use of stainless steel, corrosion resistant treatment of the entire valve—all assure low-cost, long-life service.

All these advantages are yours when you invest in 600# Hancock Steel Weldvalves. Yet they are priced right in line with ordinary valves. Your Hancock Valve Distributor is as close as your telephone. Get complete specification and operational data—phone him today.

When Hancocks go in, valve costs go down

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the facilities and experience to serve you efficiently and economically. He banks his reputation on the quality of the products he sells. You can depend on him for sound recommendations and prompt deliveries from local stocks.

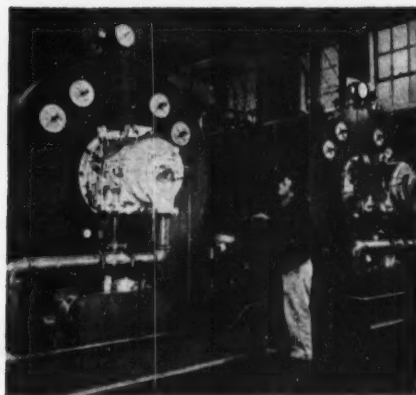
HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

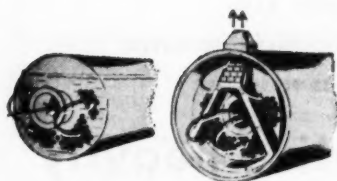


9 REASONS WHY STEAM COSTS GO DOWN

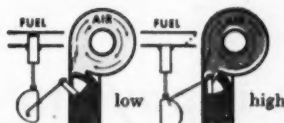


Completely Automatic Operation—Full complement of finest up-to-date operating and safety controls provides maximum operating dependability and protection with least possible attention from operator.

.....where *Powermasters* go in ...



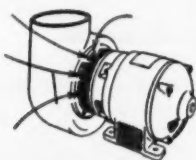
3-Pass Boiler with successive parallel paths and single gas flow reversal at each end assures most efficient flue gas velocity and heat transfer, provides maximum maintenance convenience, and requires no complex front end baffling.



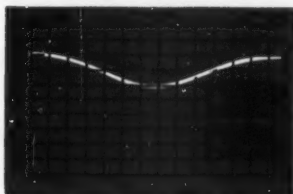
Infinitely Variable Combustion Modulation automatically maintains proper fuel-air ratio for most efficient firing at all loads. Instant response to load swings between 20% to 100% of firing rate saves fuel and assures constant steam pressure and temperature.



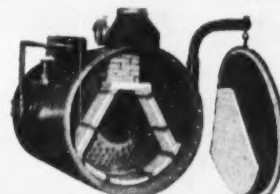
Staggered Tubes—Freedom from ineffectual boiler water eddies assures quicker heating, faster steaming, and high quality dry steam. Scrubbing action of rising water prevents corrosive gas deposits on tube surfaces.



Forced Draft provides most accurate control of combustion air supply; permits use of smaller, low-cost stack, fan and motor; requires less fan maintenance because no hot products of combustion pass through the fan.



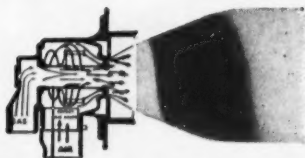
83% Guaranteed Minimum Efficiency with No. 6 oil. At less than full load, *Powermaster* efficiency actually increases! ASME field tests prove *Powermaster's* superior performance.



Easy Accessibility for tube cleaning and inspection is provided by swinging rear cover, and divided front cover that is readily removable without disturbing burner or accessories. Convenient handholes facilitate waterside inspection.



Veriflow Burners keep fuel costs low and boiler efficiency high at all loads. Air-atomizing oil burner (left) and pre-mix gas burner (right)—designed by O&S expressly for *Powermaster*—provide complete, clean combustion over full firing range. Simple, sturdy construction with no moving parts, absence of vibration, and ease of cleaning minimize maintenance. Combination burner allows quick change from one fuel to another.



Compare *Powermaster*, feature by feature, with any other package boiler and you'll readily understand why it is so widely used in industrial plants, dairies, hospitals, laundries, schools, public buildings, housing projects, institutions, and many other applications... and adding new users at a rapid rate.



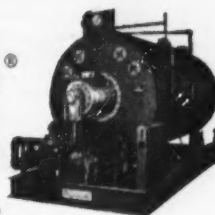
Send for this **NEW BULLETIN**

Describes and illustrates all cost-saving features of the modern, completely assembled, and factory fire-tested *Powermaster*. Ask for Bulletin 1219 on your company letterhead, stating your steam requirements and operating conditions.

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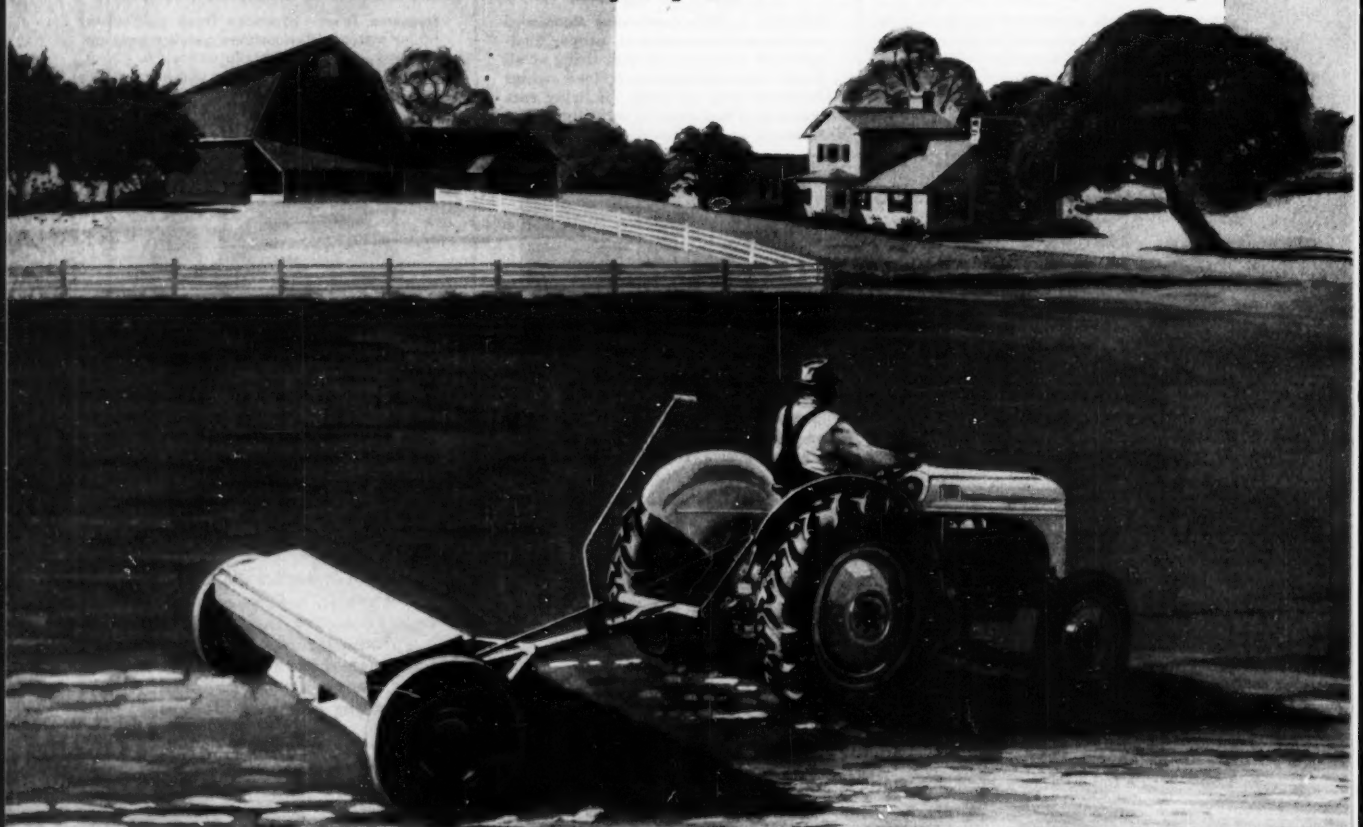
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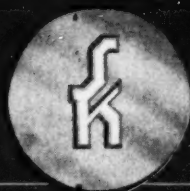
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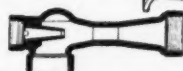


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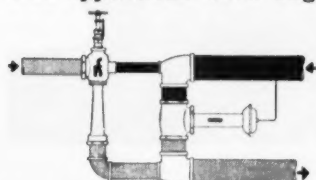
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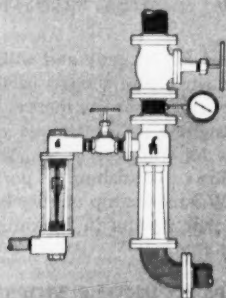
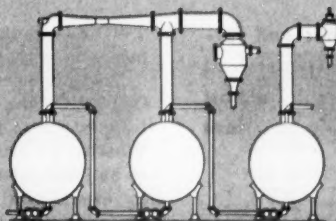


FIG. 242-B. SK Jet Eductor and SK Rotameter are used to mix liquids in desired proportion.

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SK High Vac apparatus used to cool sugar syrups after processing.

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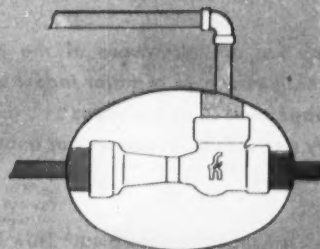


FIG. 217. SK Steam Jet Syphon mixes cold water with steam to discharge hot water.

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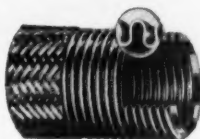
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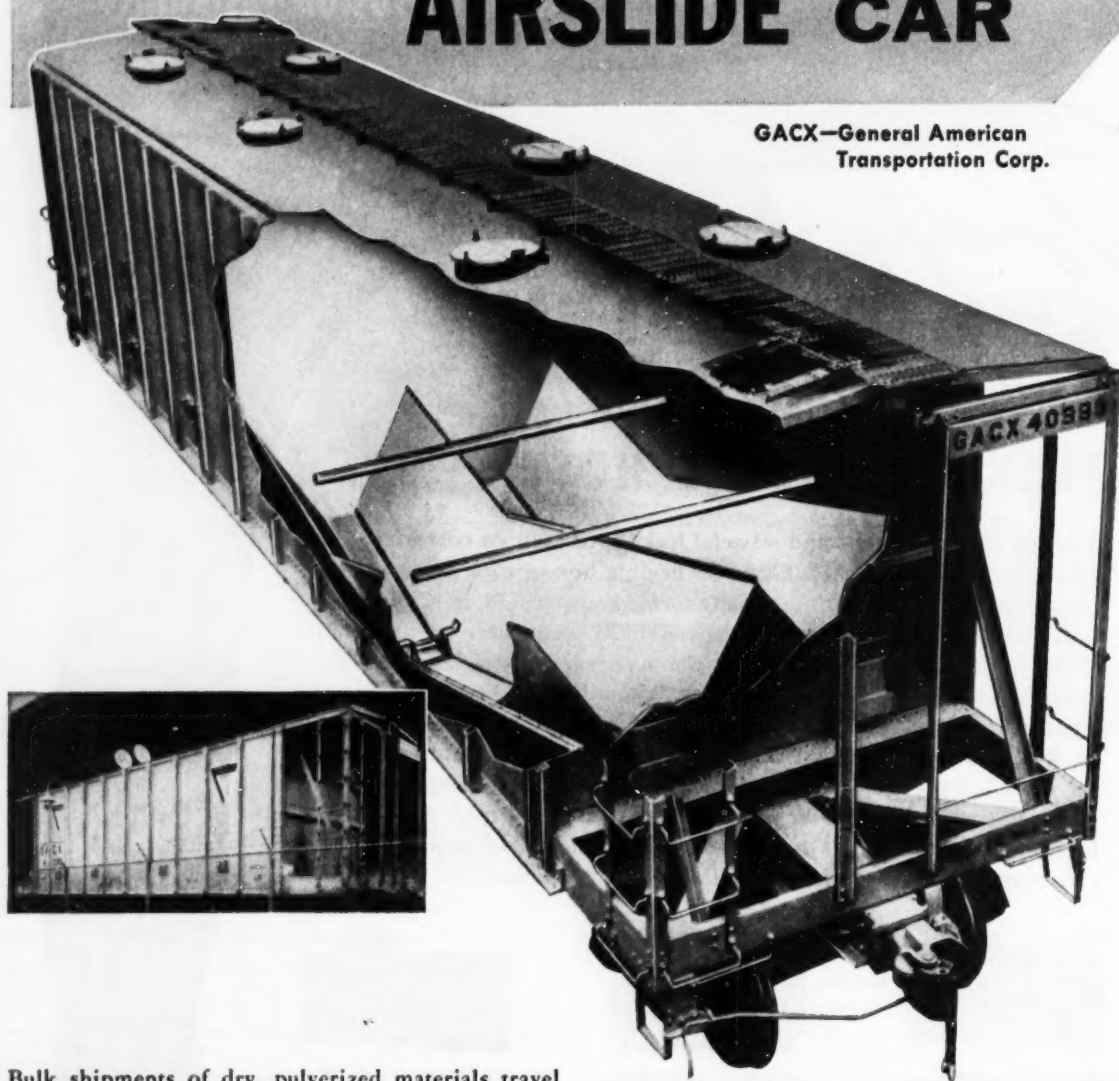


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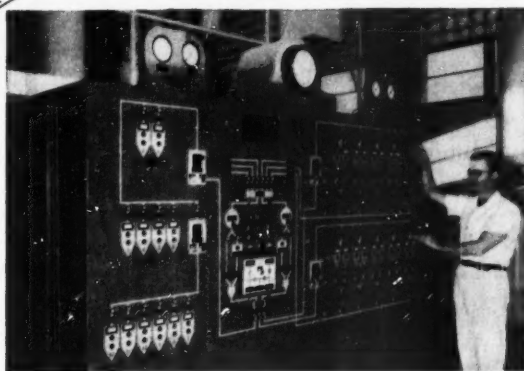
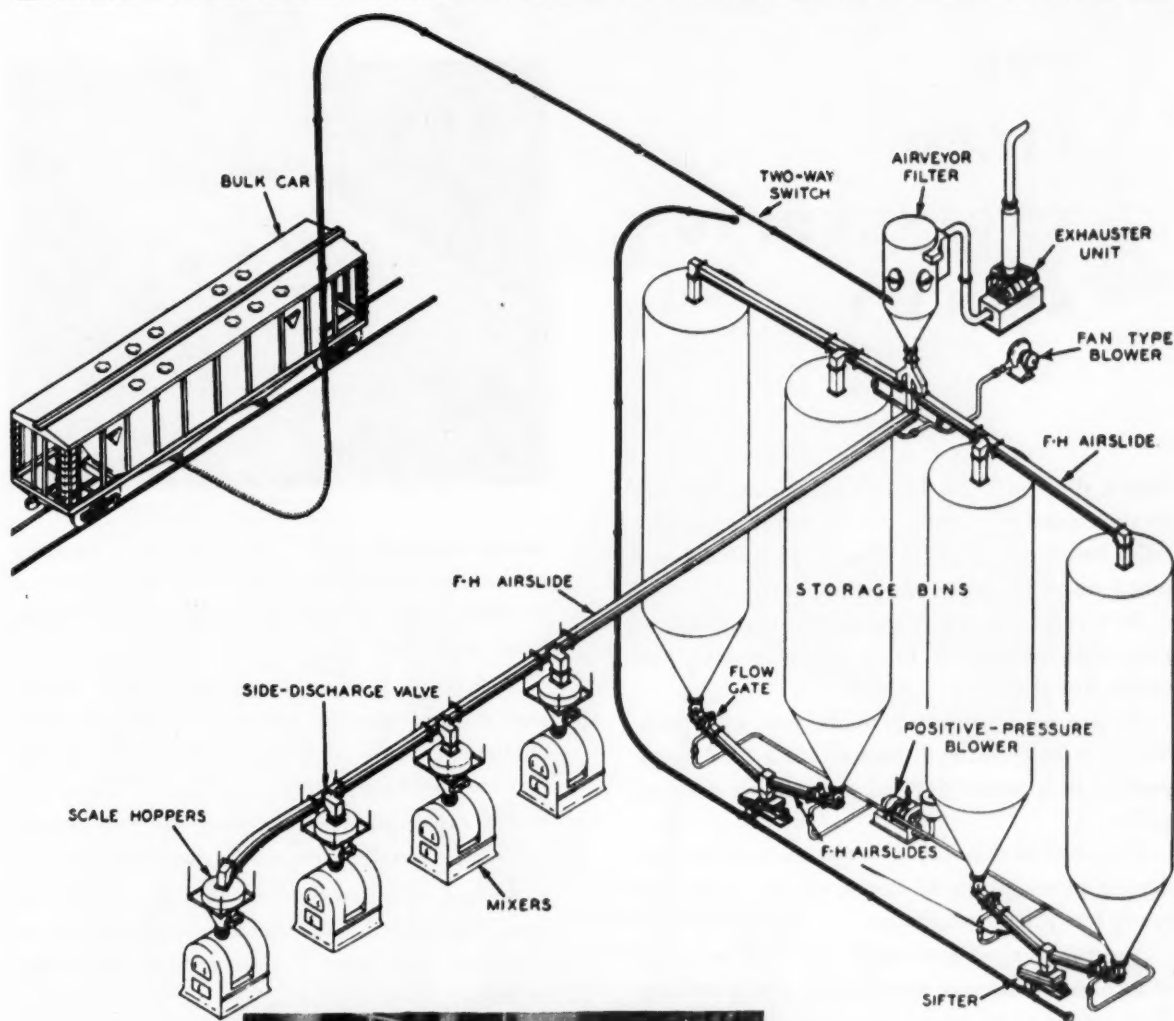
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CHEMICAL ENGINEERING—February 1954

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Wolverine U-Bend Condenser Tubes represent the last word in installation and handling efficiency. You'll also appreciate them in this form as "stand by" units.

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We have two new booklets that should interest you: Condenser Tube Book and Handbook of Practical Packaging Practices. Send for either or both.

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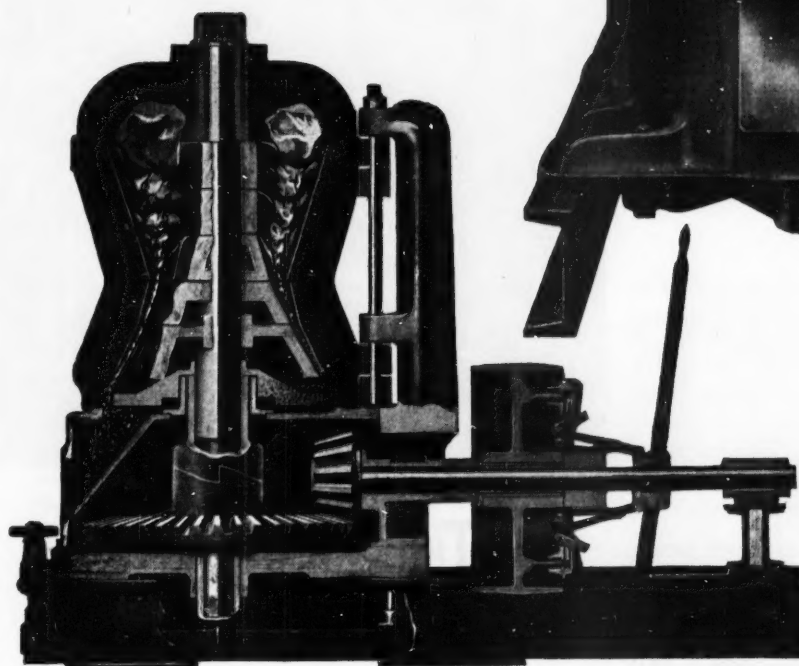
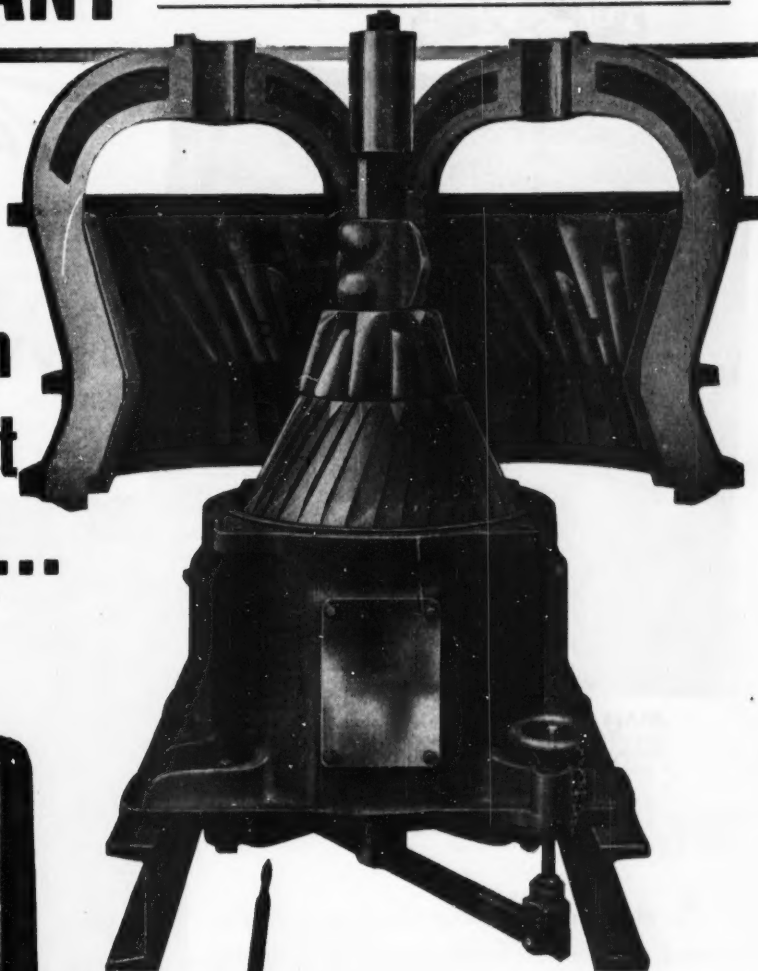
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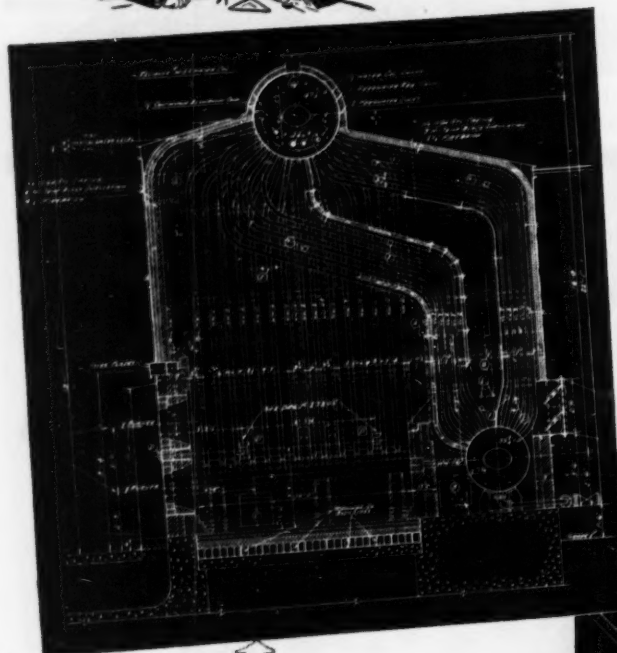
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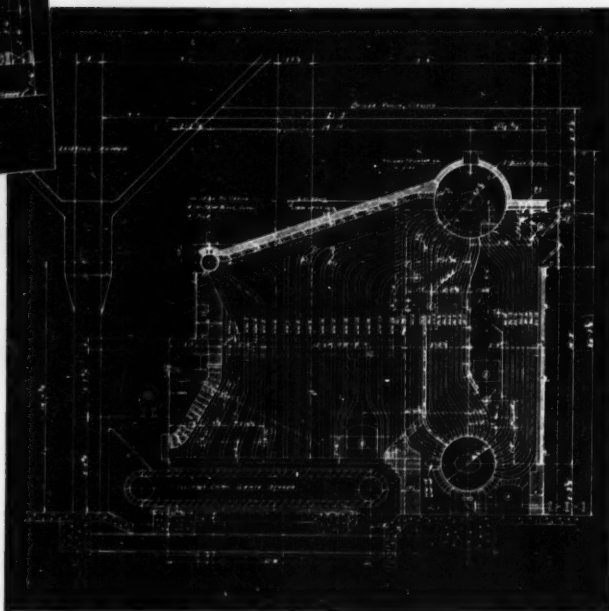
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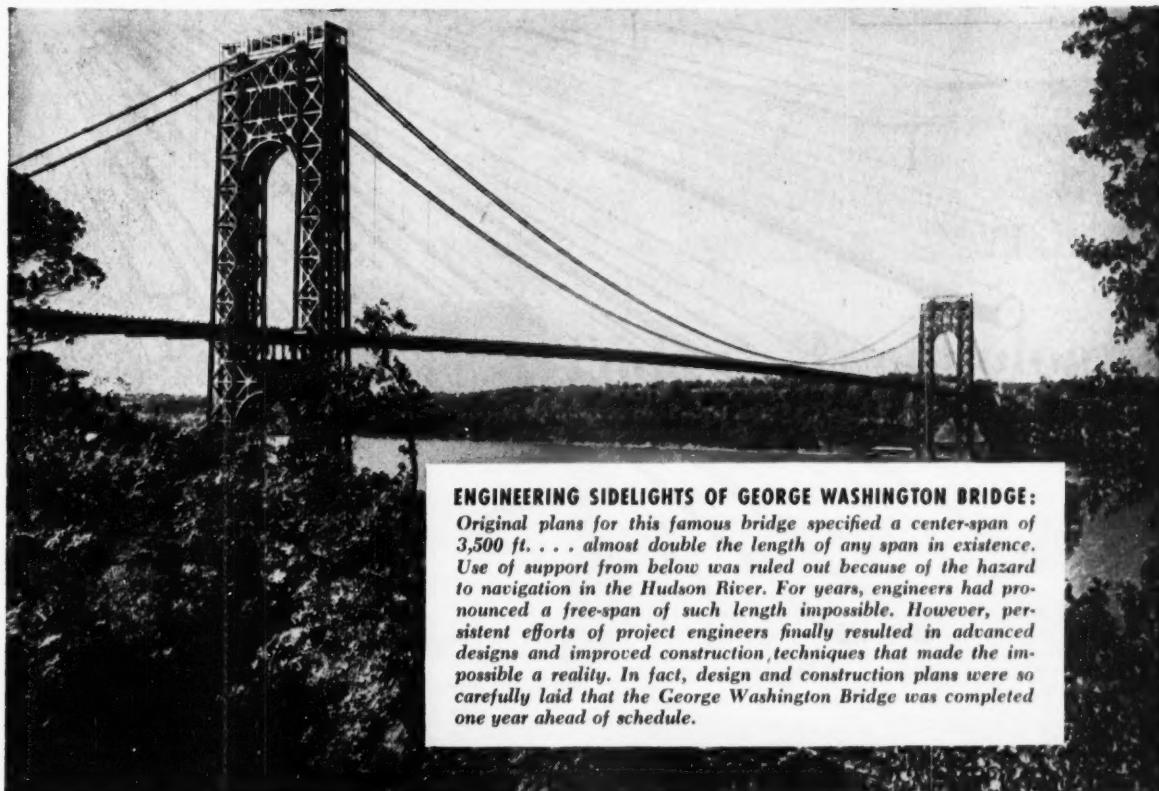


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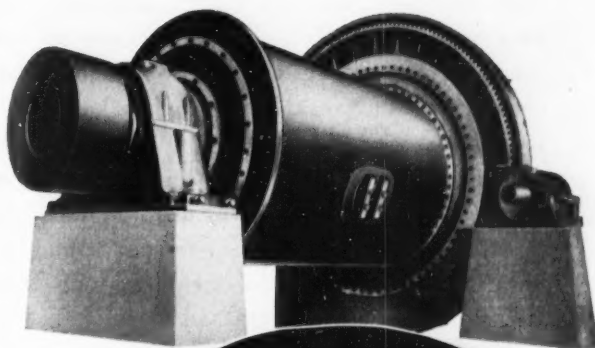
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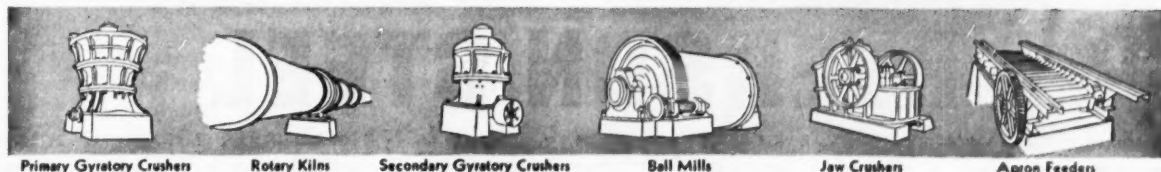
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Anhydrous NaOH: Today's Technology

**W. L. BADGER and
F. C. STANDIFORD**

Continuous finishing of caustic in Dowtherm-heated evaporators is superseding batch finishing in direct-fired pots. This progress report tells how and why.

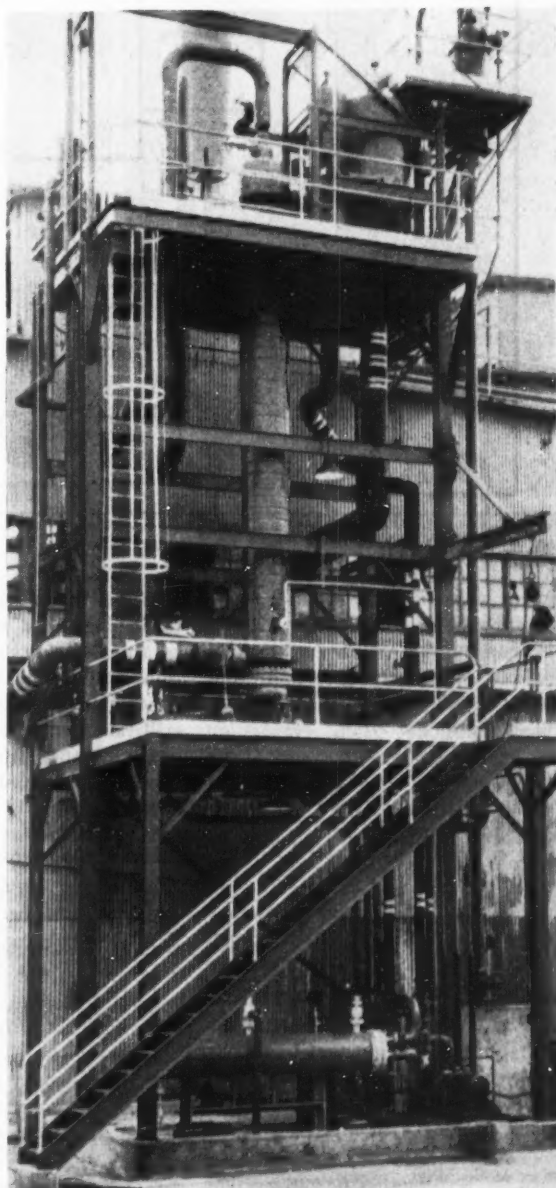
A MAJOR advance in caustic technology — continuous finishing with Dowtherm heat—was made public four years ago this month at a meeting of the American Institute of Chemical Engineers.* Although the inception of the problem dated back many years, that paper represented slightly less than four years' operating experience with a commercial unit, that of Dow Chemical Co. at Pittsburg, Calif.

At that time the Dow unit was the only one in operation whose results were available to us, although we understood that somewhat similar units were being operated by Diamond Alkali.

In the past four years much more practical experience, not only with the Pittsburg unit, but with three more recently installed ones, has been obtained. This article summarizes the

* *Chem. Eng. Prog.*, 46, 486-9 (1950).

WALTER L. BADGER, consulting chemical engineer of Ann Arbor, Mich., is well known as author of the section on evaporation in *Perry's Handbook* and as co-author of two widely used chemical engineering texts. FERRIS STANDIFORD is associated with Dr. Badger in his consulting practice.



DOW'S pioneer unit at Pittsburg has been running since 1946.

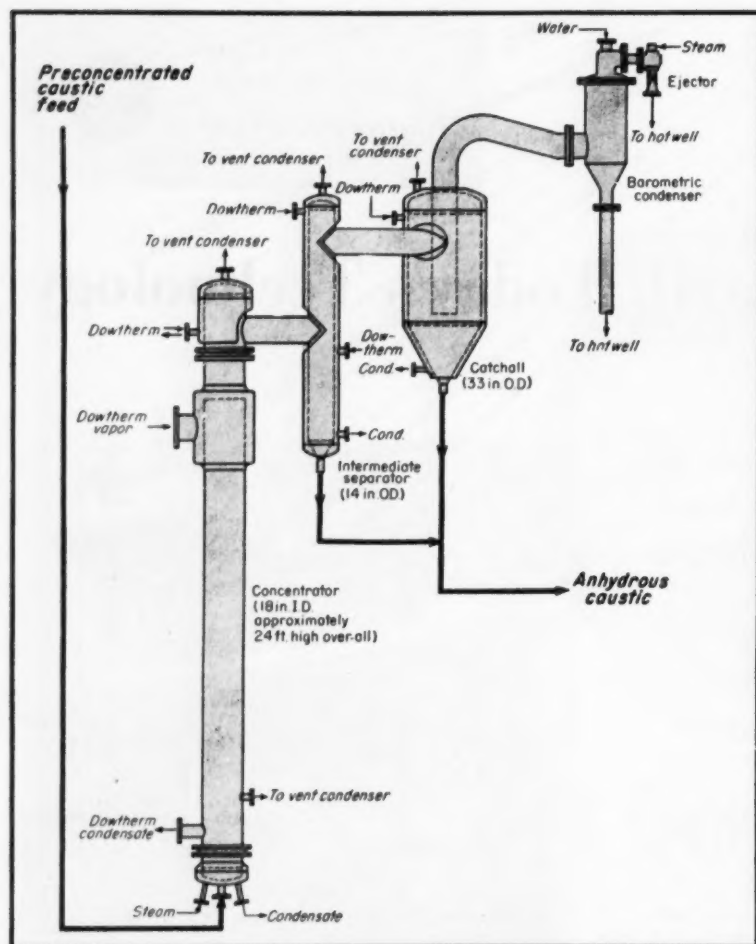


Fig. 1—ORIGINAL design provided for Dowtherm-jacketing of entire vapor system.

present status of this now firmly established process.

Compared with the conventional method used to produce anhydrous caustic soda from partially concentrated solutions—batch evaporation in open, direct-fired cast iron pots—the new process offers advantages:

1. A Dowtherm-heated evaporator installation costs only one-fifth as much as a new pot installation of the same capacity.
2. It uses only half as much fuel.
3. Maintenance expense is lower; cost of nickel tube replacements is less than half the cost of pot replacements.
4. The continuous process is entirely automatic, is much easier to control and requires practically no operator attention.

One operator estimates fuel and labor savings alone at \$2 per ton of finished caustic; another operator claims savings many times that figure.

A Dowtherm-heated finishing evaporator can be fed with either 50 or 73 percent NaOH, the usual concentrations obtained from steam-heated pre-concentrators. In a new finishing installation a separate steam-heated concentrator to bring the caustic from 50 to 73 percent NaOH is usually not economical.

FREEZE-UP CONSIDERATIONS

The original Pittsburg unit, seen in the photograph and also in Fig. 1, is still in commercial operation exactly as shown in the drawing. Only one other installation, in England, has been built along these lines.

Decision to use this design was largely influenced by the fear on the part of all concerned—both designers of the equipment and prospective operators—that it would be a problem to keep the anhydrous caustic from freezing (f.p., 612 deg. F.). The de-

sign shown was chosen because all the parts in the vapor system were small and, therefore, easily jacketed with 100-psig. Dowtherm at about 700 deg. F.

When a third unit was being considered, it seemed desirable to build it along the lines of the usual long-tube vertical evaporator, with a vapor head some 8 ft. in diameter mounted directly above the tubes. Since a jacketed vapor head would have to be designed for 100 psig. external Dowtherm pressure, its wall thickness would be 2 in. if made of solid nickel or 1½ in. if made of 10 percent nickel-clad steel. This would make jacketed construction excessively expensive, compared with the ½-in. nickel wall which could be used for an unjacketed vapor head.

This cost factor made it necessary to consider the possibility of freeze-up from a rational standpoint, rather than pure prejudice. The conclusion was reached that with 3 to 4 in. of insulation there was more than enough heat present as superheat in the vapor to take care of all losses. Further, by putting a smaller dome on the vapor head and incorporating in this a Warner "Sepratal"—an inertial-type centrifugal separator—the necessity for a large external entrainment separator was eliminated.

Since then, all units of this type have been built along the lines of the conventional long-tube vertical evaporator (Fig. 2). Startup and shutdown are extremely simple; no special precautions are taken other than to have the Dowtherm temperature near 700 deg. F. before feeding caustic.

EXPANSION PROBLEM

The original Dow evaporator was built without expansion joints; top and bottom tube sheets were rigidly attached to the shell. This construction resulted in difficulties.

Consequently, all successive units have been built with a floating lower tube-sheet and an expansion joint, as shown in Fig. 3. The only difficulty with this construction has been the strength of the liquor feed pipe, but units now in operation have been provided with sufficiently stiff feed pipes to operate the expansion joint. The feed pipes are usually Schedule 80 or heavier; the thickness depends on the flexibility of the expansion joint used.

MATERIALS OF CONSTRUCTION

It has not been necessary or desirable to deviate from the original specification of low-carbon nickel. Mond AT nickel has been found equally satisfactory in Europe; it is approximately equivalent to American low-carbon nickel.

Those parts of the equipment in contact with Dowtherm only are, of course, still made of low-carbon steel, except for bolts or other members that have to stand relatively high stresses at high temperatures.

CHLORATE REMOVAL

The dilute caustic soda solution from the diaphragm-type electrolytic cell contains a little sodium chlorate, formed by certain side reactions in the cell. The concentration usually does not exceed 2 parts NaClO_3 per thousand parts of NaOH . This chlorate content is usually of no importance to the caustic user; it is absent altogether in anhydrous caustic because it undergoes complete thermal decomposition at the temperatures used in finishing.

Chlorate is a potential source of trouble, however, in the Dowtherm-heated high concentrator. Its decomposition liberates nascent oxygen, which rapidly attacks nickel. It must be removed, therefore, before the caustic temperature reaches the thermal decomposition temperature of chlorate (about 550 deg. F.).

The earlier article described a patented process (U. S. 2,415,798) for reducing chlorate with metallic iron. However, in the first two or three years' operation it was found quite difficult to control this apparatus, with the result that the caustic going to the finishing evaporator sometimes contained unreduced chlorate and at other times contained excessive amounts of iron. Unreduced chlorate, of course, resulted in attack on the nickel; excessive iron not only had a harmful effect on the saleability of the product but actually precipitated crystalline Fe_2O_3 in the apparatus. Consequently, other reducing agents were investigated.

REDUCTION WITH SUCROSE

Most of the obvious organic reducing agents proved ineffective. Carbohydrates, however, turned out to be surprisingly effective reducing agents, and the one selected for operation in commercial practice is sucrose (U. S. 2,610,105).

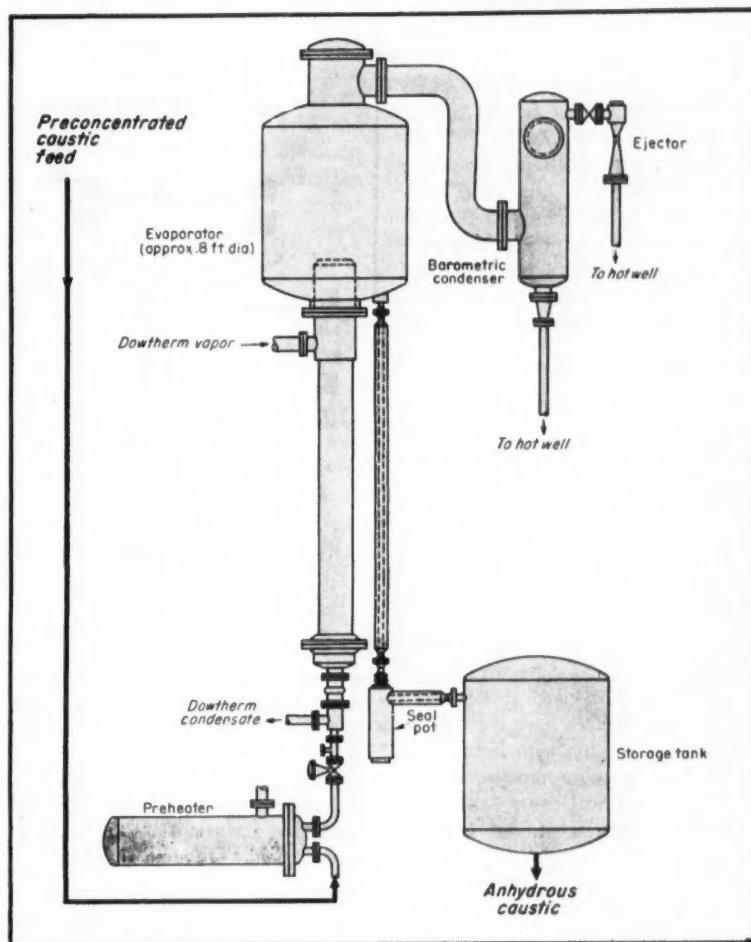
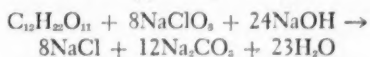


Fig. 2—REVISED design depends on thermal insulation alone to avoid freeze-ups.

Carbohydrates of high molecular weight, such as starches and cellulose, will also reduce chlorates in strong caustic solution, but their action is too slow to be complete during the passage of the liquid through the evaporator. Invert sugar (and forms containing invert, such as raw sugar and molasses) cannot be used, because the action of caustic on invert sugar produces very dark brown melassigenic acids which are extraordinarily stable and persist even in fused caustic.

The reaction by which sugar reduces chlorates is apparently as follows:



An excess of sucrose of several hundred percent over that accounted for by this reaction is necessary in practice. This amount, however, is small enough so that it does not constitute an appreciable cost—at least for chlo-

rate concentrations normally encountered—and certainly does not begin to offset the other savings accruing from the use of the Dowtherm-heated evaporator. Even on mercury-cell liquors, the use of about 1 lb. of sucrose per ton is advised to take care of possible air leaks, dissolved air in the solution and other minor sources of oxidation.

The sucrose is added as a solution of 23 to 24 deg. Baume, or a 10-deg. Baume solution can be used. The more dilute solution makes control a little easier.

The solution should be fed continuously just as close to the inlet of the evaporator as possible. If it is fed farther back in the system, high feed temperatures may evaporate some of the water in the dilute sucrose solution, giving irregular feed. Feed rate can be controlled either manually or automatically, in proportion to the

caustic feed rate. The evaporator is so stable in operation that automatic control is not essential.

Decomposition of the sucrose yields a considerable volume of gas, and if the sucrose feed is irregular this gas evolution may produce serious surging in the evaporator. On certain units orifices have been inserted in the bottoms of the tubes to prevent this surging, but other units built without these orifices have no trouble from surging when the sugar feed is regular.

IMPROVED IRON REDUCTION PROCESS

The main disadvantage in the use of sucrose for reducing chlorate is that it raises the carbonate content of the product. For a chlorate content in the feed liquor of 2 parts per thousand parts of NaOH, the necessary 8 lb. sucrose per ton of caustic will result in an increase in the carbonate content of between 0.6 and 1.5 percent. For many users this is unimportant. However, there are enough cases where carbonate specifications are so strict that we have been led to reconsider reduction with iron.

The iron reduction process, as originally practiced, was controlled by the oxidation potential of the resultant solution. The rise or fall of this potential was used to increase or decrease the amount of iron fed to the reactor. Inasmuch as there was at all times a considerable inventory of metallic iron in the reactor, this control method was not satisfactory.

The method of control has been changed, so that iron is now fed to the reactor at a constant rate and the caustic feed to the reactor is controlled by the oxidation potential. Although this gives much more satisfactory operation, it has been found extremely difficult to keep the iron as low as is demanded by many specifications.

Inasmuch as Dow at Pittsburg is operating the strontium process for the removal of iron,* it can reduce chlorate with metallic iron, let the iron in the product come out somewhat high (usually about 30 parts per million), and then remove this excess iron with the strontium treatment. The result is a feed to the evaporator completely free from chlorate and with a satisfactory iron content.

* This process involves adsorption of iron as ferrate or ferrite on finely ground strontium sulfate or carbonate.

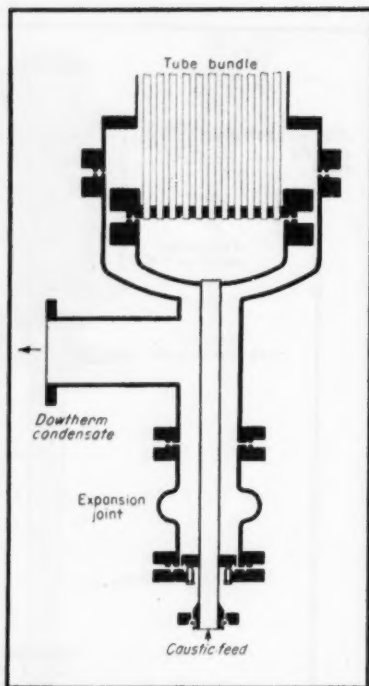


Fig. 3—EXPANSION problem was met with floating tube sheet and expansion joint.

Other users of the Dowtherm-heated finishing evaporator who do not use the strontium process continue to use sugar as a reducing agent.

MEETING QUALITY SPECIFICATIONS

Product analyzing better than 99.5 percent total solids is easily obtained; Dow has regularly produced material of better than 99.9 percent solids.

So far as specifications are concerned, however, the Na₂O content of caustic is a much more common specification than total solids. The Na₂O specification depends on the method of manufacture and the manufacturer. For diaphragm-cell caustic, which contains appreciable amounts of NaCl, Na₂SO₄, and Na₂CO₃, the specification is usually 75.0 to 75.5 percent Na₂O. For mercury-cell caustic, which contains very little impurities, it may be as high as 76.9 percent Na₂O.

With diaphragm-cell caustic containing the usual amounts of chloride and sulfate and with 2 to 3 percent carbonate, it is not at all difficult to reach 75.0 percent Na₂O. With Dowtherm temperatures of 680 to 690 deg. F., 75.3 to 75.4 percent can be obtained, but 75.5 can be reached only with Dowtherm at temperatures of 710 deg. or higher.

With mercury-cell caustic, where

there is no chlorate and where the chloride and sulfate contents are low, higher figures for Na₂O can be reached, but they also require higher Dowtherm temperatures.

Iron, chloride and sulfate contents of the finished product are determined by the composition of the material fed to the evaporator and are in no way a function of its operation. Carbonate, as already referred to, is increased by the use of sugar as a reducing agent.

NICKEL PICKUP AND TUBE LIFE

Much fear was expressed in the early days regarding attack on the nickel, both from the standpoint of product purity and evaporator life. The actual nickel pickup in the evaporator has always been clouded by the fact that in most modern caustic plants the cell liquor is handled in nickel evaporators for at least part of the way and, consequently, comes to the finishing evaporator with a certain nickel content which is rarely analytically controlled. Based on the best figures now available (and there are thousands of analyses available over a period of many years), it appears that in regular operation with good control of chlorate, the nickel pickup will not exceed 1 to 2 parts per million.

Immediately after startup, the nickel content of the product is apt to be higher. In cases where the evaporator is operated intermittently, therefore, great care should be taken to keep the evaporator full of dilute caustic solution during shutdowns, or use some other means to prevent the access of air to surfaces that will be scoured with hot anhydrous caustic. This is because action of the caustic produces a chemically clean nickel surface that picks up traces of oxygen very readily, and the resultant nickel oxide dissolves in caustic. Any air leak into the caustic circuit will likewise greatly increase the attack on nickel.

Nickel pickup directly affects the life of the tubes. The best information on tube life comes from the Dow plant at Pittsburg, where there are now over seven years of operating experience. This evaporator finishes from 60 to 75 tons of caustic per day. Present opinion is that a set of tubes will finish about 17,000 tons of solid before replacements become necessary. This figure, of course, is highly variable, depending upon conditions of operation.

At the beginning it was always supposed that it would be necessary to send the product from the Dowtherm-heated evaporator to pots for "shading." This is the addition of small quantities of chemicals (usually sulfur, sodium thiosulfate, sodium nitrate) to precipitate metallic impurities and give the finished caustic a good, white color. This step was always necessary when finishing in pots.

At Dow's Pittsburgh plant the pots were on hand, but have been used merely as storage vessels. (The evaporator runs 24 hours a day; caustic is packed or flaked only on the day shift.) No shading has been done in these pots, and plans have been made to remove the pots and substitute a nickel storage tank.

Two installations of the Dowtherm-heated evaporator have been built in plants that had no finishing pots, and in these cases nickel storage tanks were provided. These plants pack their caustic directly from the storage tanks without any thought of shading or final purification.

FINISHING OF CAUSTIC POTASH

There is not yet any unit running regularly on KOH, although many individual runs have been made at Pittsburgh on both diaphragm-cell KOH and mercury-cell KOH. Because of trade specifications, it has not been desirable to go above 92 percent KOH in the product, and this is very easily achieved with Dowtherm at 680 deg. F. For short periods of time, potash has been finished at 94 percent, and we are quite positive that 95 percent can be made with Dowtherm at 710 deg.

The boiling point of KOH is considerably higher than that of NaOH at the same concentration. This is why KOH from either pots or the high concentrator is not as highly concentrated as NaOH.

Capacity, tube life and nickel pickup are apparently approximately the same for KOH finishing as for NaOH.

DOWTHERM VAPORIZERS

In addition to considering the Dowtherm temperature that is to be used, one must also consider the design of the Dowtherm vaporizer. These vaporizers fall into two types, natural circulation and forced circulation.

The highest really safe temperature

for ordinary continuous operation of a natural-circulation vaporizer is probably 680 to 690 deg. F. Operation at 700 to 710 deg. has been accomplished with this type, but only by very careful and intelligent operation and continual checks on the Dowtherm. At 680 to 690 deg. the loss of Dowtherm by thermal decomposition is on the order of 10 percent of the charge per year. At 710 deg. in the natural-circulation vaporizer, this may go up to 25 percent or higher. A natural-circulation vaporizer operated at 710 deg. must be carefully watched for the presence of decomposition products, and provision for continuously redistilling the Dowtherm should be used.

The forced-circulation vaporizer, however, is apparently perfectly safe up to 760 deg. Rather scanty data are available for the breakdown of Dowtherm in such a vaporizer at these temperatures, but available figures indicate a loss of about 15 percent of the initial charge per year.

It follows, therefore, that the type of vaporizer to be chosen for a caustic finishing installation is dictated by the specifications that must be met by the product. Where very high NaOH contents are not necessary, the natural-circulation vaporizer is to be preferred because of the absence of circulating pumps.

FUEL CONSUMPTION

Fuel economy has been variously reported from the units in operation. In one case, fuel economy has been adversely affected by a wrong choice of oil burner. In other cases the reports fail to specify whether the figures cover only fuel consumed during operations or whether they include fuel burned to keep the installations warm during shutdowns.

One plant reports about 34 Imperial gal. of fuel oil per ton of NaOH when feeding 48 percent caustic, which corresponds to 2,850 Btu. per lb. of finished caustic. The best figures yet reached are 1.25 cu. ft. of a 1,100-Btu. gas per lb. of finished caustic when feeding 70 percent caustic. These results were obtained in a long run where all conditions were carefully controlled. In the same plant, for continuous operation, the monthly average fuel consumptions for a three-month period were 1.39, 1.58 and 1.45 cu. ft. of gas per lb. of finished solid caustic.

PAST, PRESENT AND FUTURE

There are today in actual operation four plants having a combined capacity of over 320 tons per day, and there have been sold, or are now under construction, plants with a total capacity of 240 tons per day more. A study of the installations made up to the present time, and the operating difficulties that appeared in the earlier stages, has convinced us that it is highly desirable to build the installation as a complete unit, not as an assembly of several pieces of equipment designed and purchased separately. Only in this way can the accumulated operating experience be embodied in a final successful installation.

The consensus of all operators using this process is that it is an entirely practical, satisfactory and thoroughly proven process. None of them would go back to pots.

This does not imply that the process is perfect, for there are many problems still waiting solution, such as:

1. Afterdecomposition of excess sugar has given trouble (now rectified) at one plant in getting finished caustic out of the evaporator. This afterdecomposition can also give trouble by evolving gas that bulges drums if they are sealed immediately after filling with freshly evaporated caustic.

2. Relatively reliable and inexpensive instruments for use with molten anhydrous caustic are needed.

3. Also needed are durable valves that can be used with molten anhydrous caustic without seizing.

4. These valves should have jackets so that they can be heated with Dowtherm. Then they wouldn't have to be thawed out with a torch every time they must be opened.

These problems are all relatively minor and do not affect the general conclusion that the process represents a great step forward from the days of the caustic pot.

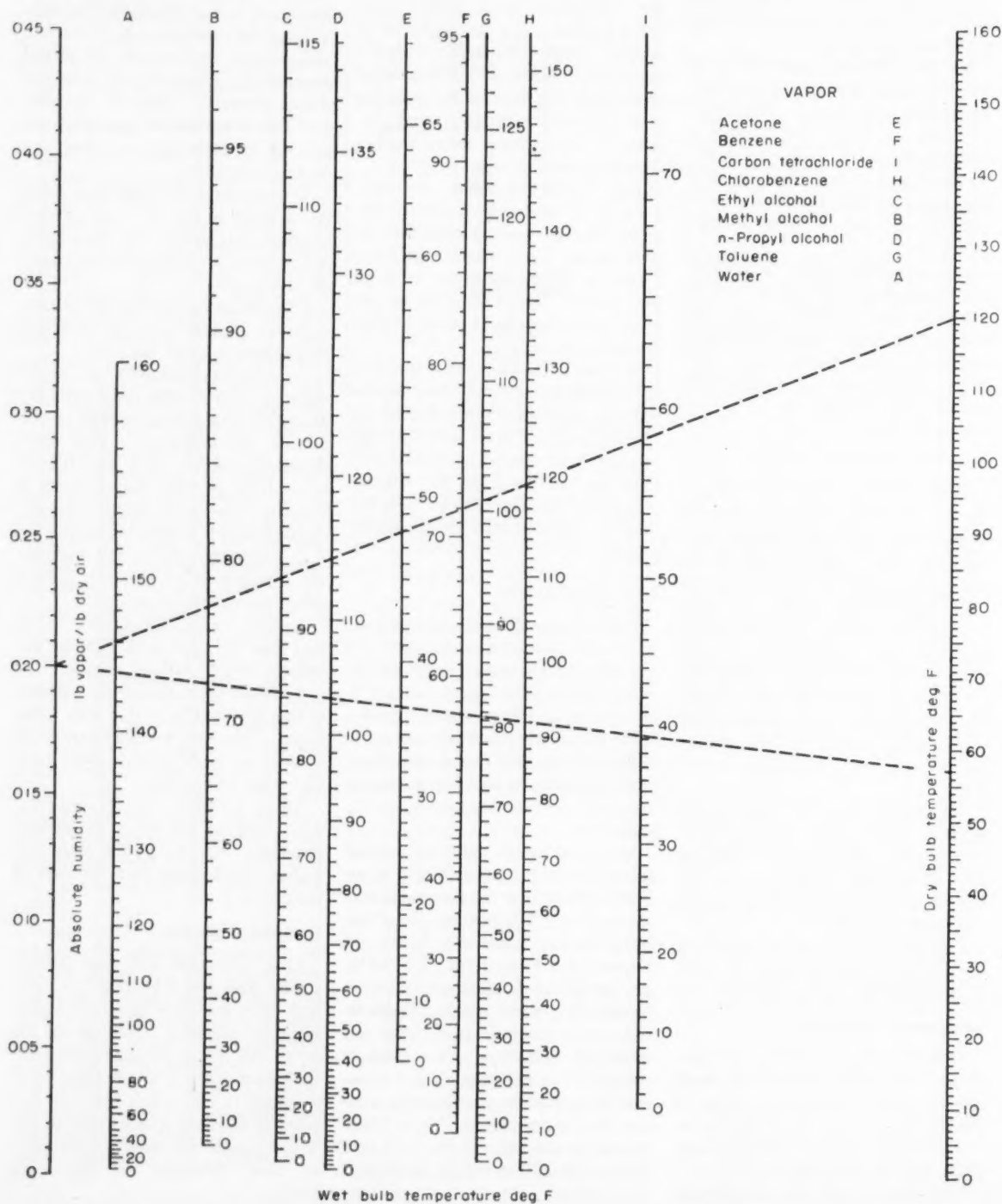
ACKNOWLEDGMENTS

Dow Chemical Co. and Murgatroyd's Salt and Chemical Co. have both been extremely generous in placing their operating results at our disposal. All the evaporating equipment (and most of the accessory equipment) discussed in this article has been supplied by Swenson Evaporator Co. The whole project has been a joint effort of Dow, Swenson and the senior author.

Here is a Nomograph to Solve Your

This simple nomograph gives the absolute humidity for common air-vapor systems.

By STUART STERN, Chemical Engineer, Wyssmont Co. Long Island City, N. Y.



Humidity Problems—Easily

Wet and dry bulb temperatures are all you need. Here's how it works.

If you've ever dealt with air-vapor systems you've probably had the problem of determining the absolute humidity of the mixture.

Your first step was to obtain the wet and dry bulb temperatures of the mixture. So far, so good. Then you hunted high and low to find a humidity chart describing your system. And, unless you were lucky enough to be dealing with one of the handful of systems whose charts have been published,^{1,2} your search went unrewarded. So you ran off a time-consuming calculation and, late and irate, came up with your answer.

NO PANACEA, BUT. . .

While no cure-all can be presented here

- Absolute humidities of the more common air-vapor mixtures are easily picked off this single nomograph.

- Construction of another line which will solve the present and future problems of your system is described.

NOMENCLATURE

A	Constant.
B	Constant.
C_g	Humid heat, Btu/(lb. dry gas content) (deg. F.).
C_p	Specific heat at constant pressure, Btu/(lb.) (deg. F.).
D_g	Molecular diffusivity in gas, sq. ft./hr.
h_g	Heat transfer coefficient, Btu/(hr.) (sq. ft.) (deg. F.).
H	Absolute humidity, lb. vapor/lb. dry air.
H_w	Saturated humidity at the wet bulb temperature, lb. vapor/lb. dry air.
k	Thermal conductivity, Btu/(hr.) (sq. ft.) (deg. F./ft.).
k_g	Mass transfer coefficient, lb. moles/(hr.) (sq. ft.) (atm.).
L_w	Latent heat of vaporization at the wet bulb temperature, Btu/lb.
M_g	Molecular weight of gas, lb./mole.
M_v	Molecular weight of vapor, lb./mole.
p	Vapor pressure of the liquid, atm.
p_w	Vapor pressure of the liquid at the wet bulb temperature, atm.
P	Total pressure, atm.
T	Dry bulb temperature, deg. F.
T_w	Wet bulb temperature, deg. F.
μ	Absolute viscosity, lb./(ft.) (hr.).
ρ	Density of gas-vapor mixture, lb./cu. ft.

KEY RELATIONSHIP

When the humidity chart for a system is unavailable, recourse must be made to the relationship³

$$H = H_w - \frac{h_g}{k_g M_g P L_w} (T - T_w) \quad (1)$$

and a calculation of the absolute humidity made.

The solution of this equation is tedious. Not only must you have the measured values of the wet bulb and dry bulb temperatures; but you must also have on hand the saturation humidity, latent heat of vaporization of the liquid at the wet bulb temperature and the value of $h_g/k_g M_g P$ for the system. If, as in the case of design problems, the wet bulb temperature is not known, the task of solving the equation becomes even more onerous. A value for the absolute humidity must be assumed and the problem solved by trial and error.

Saturation humidity at the wet bulb temperature is a function of the wet bulb temperature and can be expressed in terms of the vapor pressure.

$$H_w = \frac{p_w}{M_g/M_v (1 - p_w)} \quad (2)$$

Substituting Eq. (2) in Eq. (1):

$$H = \frac{p_w}{M_g/M_v (1 - p_w)} - \frac{h_g}{k_g M_g P L_w} (T - T_w) \quad (3)$$

The equation for the vapor pressure of a liquid is

$$\log p = A - \frac{B}{T + 460} \quad (4)$$

At the wet bulb temperature this expression for the vapor pressure is

$$p_w = \log^{-1} \left(A - \frac{B}{T_w + 460} \right) \quad (5)$$

Substituting Eq. (5) in (3), we get

$$H = \frac{\log^{-1} \left(A - \frac{B}{T_w + 460} \right)}{M_g/M_v \left[1 - \log^{-1} \left(A - \frac{B}{T_w + 460} \right) \right]} - \frac{h_g}{k_g M_g P L_w} (T - T_w) \quad (6)$$

You can obtain a value of the term $h_g/k_g M_g P$ from the Chilton-Colburn analogy⁴

Here Are Some Typical Examples

Problem: Determine the absolute humidity of benzene in air at a wet bulb temperature of 72 deg. F. and a dry bulb temperature of 120 deg. F. **Solution:** Connect the dry bulb temperature of 120 deg. F. with the wet bulb temperature of 72 deg. F. and read the absolute humidity, 0.2 lb. vapor/lb. dry air.

Problem: Determine the saturation humidity of benzene vapor in air when the air temperature is 57.0 deg. F. **Solution:** Connect the dry bulb temperature of 57.0 deg. F. with a wet bulb temperature of 57.0 deg. F. and read the absolute humidity, 0.2 lb. vapor/lb. dry air.

Problem: Determine the dew point of benzene when the dry bulb temperature is 75 deg. F. and the absolute humidity is 0.2 lb. vapor/lb. dry air. **Solution:** Pivot a straightedge about absolute humidity reading until the wet bulb and dry bulb temperatures are equal. This is the dew point.

$$\frac{h_g}{k_g M_g P} = C_g \left(\frac{\mu/\rho D_g}{C_p \mu/k} \right)^{1/3} \quad (7)$$

Sherwood and Pigford⁵ present a tabulation of $\mu/\rho D_g$ values for some 35 compounds. From these you can calculate your $h_g/k_g M_g P$ value.

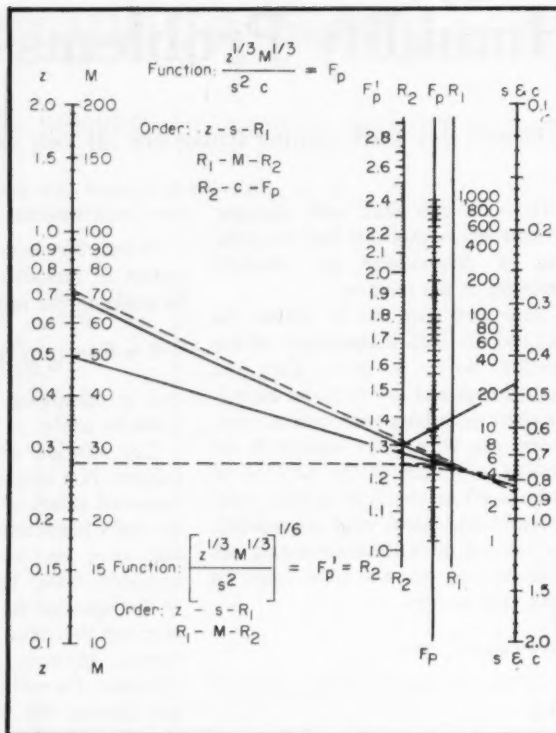
By assuming that the latent heat of vaporization remains constant over the range of wet bulb temperatures selected, the number of variables is reduced to three, T , T_w and H .

The method for constructing the three-line nomograph is that presented by Allcock and Jones⁶ for class III, genus zero nomographs.

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4. Sherwood, T. K. and Pigford, R. L., "Absorption and Extraction," 2nd Edition, p. 99, McGraw-Hill Book Co., New York, 1952.
5. Ibid., p. 20.
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	TUBE SIDE			SHELL SIDE
	Condensate			
	Vapor	Compound		
X		Y		
Composition, wt. %				
Benzene.....	74.1	86.0	4.8
Ethanol.....	18.5	12.7	52.1	....
Water.....	7.4	1.3	43.1	100
Rates, lb./hr.....	14,480	12,400	2,080	218,000
Temperatures, °C.				
High.....	65	65	65	41
Intermediate.....	....	65	65	....
Low.....	....	35	35	30
Physical Properties				
Specific heat, Btu./lb./°F.		0.47	0.79	1.0
Viscosity, centipoises				
Liquid.....	....	0.50	0.72	0.72
Vapor.....	0.009	....	....	....
Molecular weight.....	56.8	69	27.8	18
Specific gravity.....	....	....	....	1.0
Liquid.....	....	0.842	0.868	1.0
Vapor.....	0.002	....	....	....
Latent heat, Btu./lb.....	....	209	635	....
Materials of construction..		Copper	....	Steel
Allowable pressure drop, psi.		0.25	....	5
Fouling factor.....		None	....	0.001
Suggested tube size and length— $\frac{1}{4}$ " O.D. X No. 16 BWG X 12 ft. long.				



Design data for condenser and subcooler (immiscible fluids). Liquid physical property factor for heat transfer.

Shortcut to Heat Exchanger Design—V

You can cut in half the time for designing heat exchangers by the conventional methods. Here's how for conditions of vapor deposition and condensate subcooling, condensates of immiscible liquids, and cross flow in shell.

C. H. GILMOUR

Although the majority of the heat transfer problems involving condensation and subcooling of vapors will be for cases in which the condensates consist of one component or miscible components, there are a few cases in which the condensates consist of mixtures which are immiscible. There is some evidence that the heat transfer coefficients are higher than would be expected if the mixture were considered to be homogeneous. The reason for this is probably that drop-wise condensation sometimes exists. Test data on a considerable number of condensers containing immiscible

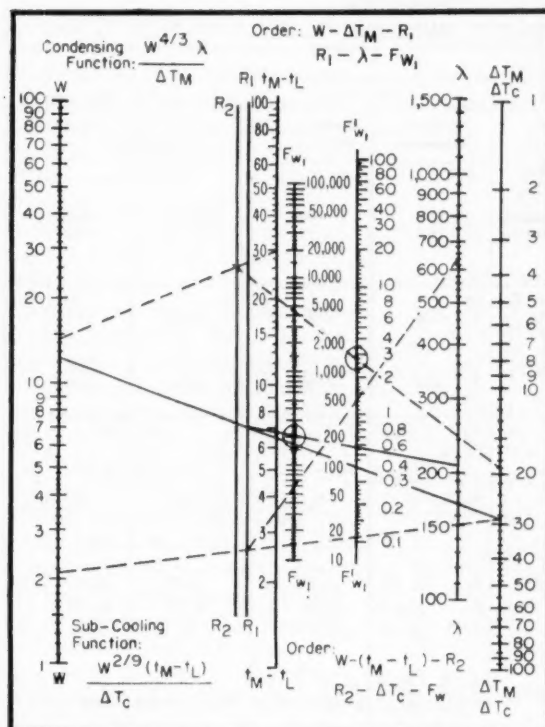
fluids indicate that the heat transfer coefficient is usually less than would be obtained if it were assumed that the mixture were homogeneous. The most conservative approach in the design of the condensing zone for condensers containing immiscible fluids is to assume that there are two separate condensate films in parallel through which the entire heat of condensation must pass before reaching the tube wall.

For reasons presented in Article IV only the vertical vapor-in-tube condenser and subcooler is considered in this series.

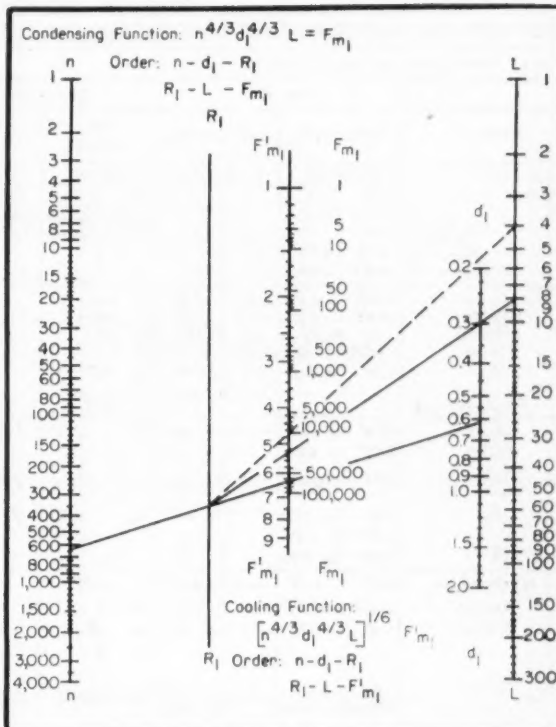
The heat transfer coefficient for each of these films is calculated from the Nusselt formula in which the physical properties and the tube load-

ing for each fluid are used. In writing the heat balance equation for each one of the fluids the product of the heat transfer coefficient, the area, and the ΔT are equated to the total heat load. Let us designate one of the immiscible constituents as compound x and the other immiscible constituent as compound y. The total heat load will then be the weight rate of compound x times its latent heat of vaporization plus the weight rate of compound y times its latent heat of vaporization (Eq. V-3). When this equation is rationalized by the methods used in the previous articles the final equation for each constituent is almost the same as the equation for condensing miscible fluids. The only difference is that there is an additional

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Work factor for heat transfer.



Mechanical design factor for heat transfer.

term to be used as a multiplier to the work factor. This term for the x compound is equal to $(1 + W_x \lambda_x / W_y \lambda_y)$; for the y compound this multiplier is $(1 + W_y \lambda_y / W_x \lambda_x)$ (Eq. V-7 and V-8). The ratio of course represents the ratio of heat loads of each immiscible constituent and the ratio of the y constituent to the x constituent is designated by ϕ .

The final equations for each immiscible constituent consist of a numerical factor, a physical property factor, two work factors, and a mechanical design factor. In making the final computations for condensing, there will be a summation of five factors instead of the usual four. Since these films are in parallel the mechanical design factor will be exactly the same for both compound x and compound y.

PRESSURE DROP CALCULATIONS

In making the pressure drop calculations for the tube side the physical properties of the vapor entering the condenser are to be used. Thus, the viscosity will be that of the vapor before condensation has taken place and the specific gravity will also be for the

same vapor relative to liquid water. The weight rate of flow to be used in the work factor for pressure drop will be the total weight of vapor entering the condenser. In the mechanical design factor, the length of the shell L_s will be the sum of the condensing length which is designated as L_a and the subcooling length which is designated as L_b .

About "Shortcuts to Heat Exchanger Design"

NOTE—The first article in this series (Oct. 1952, p. 144) developed a basic method for the design of heat exchangers. Use of the method for conditions of no phase change, forced convection, turbulent flow, and cross flow in shell was described.

Article II in the March issue (p. 226) described the use of the basic method for conditions of no phase change, forced convection, turbulent flow, and parallel flow in shell.

Article III in the April issue dealt with heaters and condensers in which the condensing vapors contain no more than a small amount of superheat or non-condensable vapor.

SUBCOOLING ZONE

Because the film in the subcooling zone was formed in the condensing zone one might suspect that the mechanism of heat transfer in the subcooling zone will be the same as in the condensing zone. This is not so. In the condensing zone there is a positive temperature gradient across the film due to the presence of hot

Article IV in the October issue dealt with condensers and subcoolers in which the condensate consists of miscible fluids. Remaining articles will deal with condensation and cooling of mixtures of condensable and non-condensable gases, and with the change in phase known as boiling or evaporation.

It will be necessary to refer to the first article for certain alignment charts, nomenclature, as well as development of the basic method. When you do, please note that W_s was omitted under work factors for pressure drop in Eq. VII. In this same equation the exponent on the term P is a 3.—EDITOR.

COMPUTATIONS FOR HEAT EXCHANGERS
FOR VERTICAL VAPOR-IN-TUBE CONDENSERS AND SUB COOLERS, IMMISCIBLE FLUIDS, CROSS FLOW IN SHELL

HEAT TRANSFER CALCULATIONS:

HEAT EXCHANGER DESIGN DATA SHEET														
Material		Tube Side				Shell Side				Tube Wall		Fouling		
		Condensing		Sub-Cooling		Gas Liquid		Gas Liquid		Copper	Steel	Scale	For	
		Compound		Compound		Spacing		Spacing		Stainless	Sheet	Polymers		
Numerical factor F_n	Compound		Compound		Spacing		Spacing							
	X	Y	X	Y	Tri.	Sq.	Tri.	Sq.						
	Gas Liquid Vapor °C	Gas Liquid Vapor °F												
	475	475	1.22	1.22	0.475	0.604	0.475	0.604	159	159	3820	3820	3820	3820
	475	475			0.270	0.342	0.270	0.342						
Liquid physical property factor F_p	0.47 C_1	0.79 C_1	0.47 C_1	0.79 C_1	1.0 C_0	1.0 C_0	1.0 C_0	1.0 C_0	1	1	1	1	1	1
	0.50 Z_1	0.72 Z_1	0.50 Z_1	0.72 Z_1	0.72 Z_0	0.72 Z_0	0.72 Z_0	0.72 Z_0	1	1	1	1	1	1
	69 M_1	27.8 M_1	69 M_1	27.8 M_1	1.8 M_0	1.8 M_0	1.8 M_0	1.8 M_0	1	1	1	1	1	1
	0.842 S_1	0.868 S_1	0.842 S_1	0.868 S_1	1.0 S_0	1.0 S_0	1.0 S_0	1.0 S_0	1	1	1	1	1	1
	10 F_p	4.6 F_p	1.3 F_p	1.24 F_p	1.75 F_{p0}	1.75 F_{p0}	1.75 F_{p0}	1.75 F_{p0}	1	1	1	1	1	1
For gases →			$F_{pX} + F_{pY}$	1.27	Omit	Omit	Omit	Omit						
Work factor $\Phi_X = \frac{W_X \lambda_X}{W_Y \lambda_Y} = \frac{1}{\Phi_Y}$ F_w $F_{w2} = 1 + \Phi$	12.4 W_1	2.08 W_1	$W_X + W_Y = W_1$	2.08 W_1	218 W_0	218 W_0	218 W_0	218 W_0	1	1	1	1	1	1
	2.09 λ_1	635 λ_1	$1 - T_L$	30	$T_H - T_M$	10	1	$T_M - T_L$	10	1	1	1	1	1
	28.6 ΔT_M	28.6	ΔT_C	19.5	ΔT_M	28.6	19.5	ΔT_C	19.5	1	1	1	1	1
	210 F_{w1}	59	F_{w1}	2.8	F_{w0}	48	7	F_{w0}	76	11.2	76	11.2	76	11.2
	0.51 Φ	1.96												
	1.51 F_{w2}	2.96												
Mechanical design factor F_m	637 n	637	n	637	1	1	1	1	1	1	1	1	1	1
	0.62 d_1	0.62	d_1	0.62	N_{PT}	1	1	N_{PT}	1	1	1	1	1	1
	8 L_A	8	L_B	4	L_A	8	4	L_B	8	4	8	4	8	4
					11.1 P	11.1	11.1 P	11.1						
	$\frac{1}{23200 F_m}$	$\frac{1}{23200}$	$\frac{1}{F_m}$	$\frac{1}{4.1}$	F_{m0}	0.0046	0.0092	F_{m0}	$\frac{d_0 - d_1}{nd_0 L_A}$	0.13	0.13	$\frac{d_0 - d_1}{nd_0 L_B}$	$\frac{1}{nd_0 L_A}$	$\frac{1}{1580}$
Product $F_n \times F_p \times F_w \times F_m$ $\times F_{w2}$	0.650	0.164	Sub-Cooling	0.104	Sub-Cooling	0.002	Sub-Cooling	0.092	Sub-Cooling	0.0006	Condensing	0.027	Sub-Cooling	0.027
			Condensing	0.915	Condensing	0.030	Condensing	0.0006	Condensing	0.0006	Condensing	0.027	Condensing	0.027
PRESSURE DROP CALCULATIONS:														
	Tube Side				Shell Side				Product tube		X	0.650		
											Y	0.164	0.915	
Physical property factor f_p	$Z_{v1} 0.009 = 0.9 \times 0.1 \times 0.1$ $S_{v1} 0.002 = 0.2 \times 0.1 \times 0.1$ $f_{p1} 5 \times 6.5 \times 6.5 = 2/2$				$f_{p0} = 0.326/S_0$				Product shell			0.104	0.030	
									Product wall			0.002	0.001	
Work factor f_w	14.4 $f_{w1} = (W_1/n)^{1.8}$				47500 $f_{w0} = W_0^2$				Product fouling			0.092	0.027	
	0.0011								Sum of products			1.012	0.973	
Mechanical design factor f_m	L_0/d_1 19 Plus 25 f_{d1} 46 f_{m1} 0.42 $f_{m2} = 0.5$				$f_{m0} = \frac{L_A + L_B}{P^3 D_0}$				This sum must be equal to or less than 1 for each column					
$f_p \times f_w \times f_m$	0.049				5.0				$L_0 = L_A + L_B$					
MEAN TEMPERATURE DIFFERENCE AND TEMPERATURE CHANGE														
$T_H - T_H$ 24			T_H 65		T_H 41		T_H	Item No. Benzene-Ethanol-Water Condenser-Subcooler		Surface area		1500	Sq. ft.	
$T_M - T_M$ 34			T_M 65		T_M 31		T_M			Size:				
$T_L - T_L$ 5			T_L 35		T_L 30		T_L			Number of tubes		637		
Diff. 10			$T_M - T_L$ 30 (a)	(f) / (d) 103	$T_M - T_L$					Outside diameter of tubes		3/4"		
Ratio 1.42			1.8 $(W_X C_X + W_Y C_Y)$ 13.5 (b) °C	10	$T_H - T_M$					Length of shell or length of single tube pass		12'		
ΔT_M 28.6			$(W_X C_X + W_Y C_Y)$ (b) °F	11	$T_H - T_L$					Inside diameter of shell		27"		
Sum			(a) x (b) 405 (c)	(c) 405	(a) x (b)									
$-2 \Delta T_C$ 19.5			$W_X \lambda_X + W_Y \lambda_Y$ 3910 (h)	(f) 4450	(c) x (e)									
			(c) + (h) 4305 (d)	(f) / (d) 103	$T_M - T_L$									
$(T_H + T_M) / 2$ 48			$T_M - T_L$ 13 (g)	$(T_H + T_M + T_L) / 6$ 44										

$$W_x \lambda_x + W_y \lambda_y = 12.4 \times 209 + 2.08 \times 635 = 2590 + 1320 = 3910$$

vapor on one side and the cold tube wall on the other side, and except for the increase in film thickness due to deposition of condensate as the condensing process proceeds, a steady state of heat transfer exists.

When condensation is complete the mechanism of heat transfer is quasi-unsteady state. The film is in contact with the wall at essentially constant temperature and the instantaneous heat transfer is by conduction from one side of the film. But the film is moving, and the velocity at the wall is lowest due to friction while at the outer face of the film (furthest from the tube wall) it is highest because there is no force at this point to counteract the force of gravity.

The net effect of friction is to slow the film down at the wall so that the tube wall tends to become dry. But before this condition can actually take place, the outermost part of the film flows toward the wall and replaces the sluggish film just above it. Thus there is a movement of mass to and from the wall of the tube as this process repeats itself along the length of the tube. This intermittent contact of hot liquid with cold wall accounts for the major part of the heat transfer.

In a film consisting of immiscible liquids there is equal opportunity for each liquid to come in contact with the wall so that in the subcooling zone the design equations are like those for a homogeneous condensate. The average of the physical property factors for the two immiscible constituents is used for the physical property factor, and the weight rate of flow is the total weight of material flowing—or $W_x + W_y$. There is only one tube side factor for the subcooling zone instead of the two that are required for the condensing zone. The final design equations for subcooling are shown in Eqs. V-13 and V-14.

EXAMPLE

To illustrate the use of the design equations and computation sheet for this case, a condenser will be designed for the following duty. 2,000 gph. of a vapor containing 74.1 percent benzene, 18.5 percent ethanol and 7.4 percent water is to be condensed at substantially atmospheric pressure and the condensate is to be subcooled to 35 deg. C. using cooling water entering at 30 deg. C.

Condensate formed from this vapor

For Condensing — Immiscible Condensates

$$h_x = 0.925 k_x \left[\frac{g\rho^2}{\mu\Gamma} \right]_x^{1/3} \frac{d_i}{d_o} \quad (V-1)$$

$$h_y = 0.925 k_y \left[\frac{g\rho^2}{\mu\Gamma} \right]_y^{1/3} \frac{d_i}{d_o} \quad (V-2)$$

$$h_x A \Delta T_x = W_x \lambda_x + W_y \lambda_y = h_y A \Delta T_y \quad (V-3)$$

$$\Delta T_x = (W_x \lambda_x + W_y \lambda_y) / h_x A; \quad \Delta T_y = (W_x \lambda_x + W_y \lambda_y) / h_y A \quad (V-4)$$

$$\frac{\Delta T_x}{\Delta T_m} = 8.55 \left[\frac{M^{1/3} z^{1/3}}{c s^2} \right]_x \frac{W_x^{1/3} (W_x \lambda_x + W_y \lambda_y)}{\Delta T_m} \frac{1}{n^{4/3} d_i^{4/3} L_A} \quad (V-5)$$

$$\frac{\Delta T_y}{\Delta T_m} = 8.55 \left[\frac{M^{1/3} z^{1/3}}{c s^2} \right]_y \frac{W_y^{1/3} (W_x \lambda_x + W_y \lambda_y)}{\Delta T_m} \frac{1}{n^{4/3} d_i^{4/3} L_A} \quad (V-6)$$

$$\frac{\Delta T_x}{\Delta T_m} = 8.55 \left[\frac{M^{1/3} z^{1/3}}{c s^2} \right]_x \frac{W_x^{4/3} \lambda_x}{\Delta T_m} \left[1 + \frac{W_y \lambda_y}{W_x \lambda_x} \right] \frac{1}{n^{4/3} d_i^{4/3} L_A} \quad (V-7)$$

$$\frac{\Delta T_y}{\Delta T_m} = 8.55 \left[\frac{M^{1/3} z^{1/3}}{c s^2} \right]_y \frac{W_y^{4/3} \lambda_y}{\Delta T_m} \left[1 + \frac{W_x \lambda_x}{W_y \lambda_y} \right] \frac{1}{n^{4/3} d_i^{4/3} L_A} \quad (V-8)$$

$$\frac{\Delta T_x}{\Delta T_m} = \left[F_n \times F_p \times F_w \times (1 + \phi_x) \times 1/F_m \right]_x \quad (V-9)$$

$$\frac{\Delta T_y}{\Delta T_m} = \left[F_n \times F_p \times F_w \times (1 + \phi_y) \times 1/F_m \right]_y \quad (V-10)$$

$$\frac{\Delta T_x}{\Delta T_m} = \left[F_n \times F_p \times F_w \times F_{w2} \times 1/F_m \right]_x \quad (V-11)$$

$$\frac{\Delta T_y}{\Delta T_m} = \left[F_n \times F_p \times F_w \times F_{w2} \times 1/F_m \right]_y \quad (V-12)$$

For Subcooling — Immiscible Condensates

$$\frac{\Delta T_i}{\Delta T_c} = 1.22 \left[\frac{M^{1/3} z^{1/3}}{s^2} \right]_{Ave}^{1/6} (W_x + W_y)^{2/9} \frac{(t_M - t_L)}{\Delta T_c} \left[\frac{1}{n^{4/3} d_i^{4/3} L_B} \right]^{1/6} \quad (V-13)$$

$$\frac{\Delta T_i}{\Delta T_c} = F'_n \times F'_p \times F'_w \times 1/F'_m \quad (V-14)$$

will consist of two immiscible fluids each containing all of the constituents present in the incoming vapor but in different percentages. The process engineer should supply the condenser designer with the information shown herein in tabular form because the latter would not necessarily know when a condensate is apt to consist of immiscible fluids.

The information from the "Data for Design" supplied by the process engineer is transposed to the computation sheet preparatory to the final computations by slide rule and nomographs. Note that the tube side column is divided into two columns, one for condensing and one for subcooling and that these are each divided into two columns, one for immiscible component x and the other for immiscible component y. For reasons indicated

in the development of the design equations, only the physical property factor for each constituent x and y is required for the subcooling zone and these are averaged for the final physical property factor. Therefore, there will be only one final factor for subcooling consisting of the product of the numerical factor, the averaged physical property factor, the work factor using the total condensate rate, and the mechanical design factor. The "condensing" column will have two factors, one for the x component and one for the y component.

The shell side, tube wall, and fouling columns will be treated in the manner shown in Article I with the exception that there are two columns for each, the left hand column for "condensing" and the right hand column for "subcooling."

In making the pressure drop calculations it must be remembered that physical properties and weight rate of flow of the vapor to the condenser are used rather than liquid properties.

In the calculations to be made in that portion of the computation sheet designated "mean temperature difference and temperature change" certain steps in simple arithmetic are called for. Whenever a letter appears in parentheses, it is not to be confused with a physical property. It is merely a way of designating a factor which is the result of simple arithmetic performed as indicated within the immediate part of the chart. It will be necessary to use the margins of the chart or a separate piece of scratch paper to do some of the arithmetic but there is room for the results on the computation sheet. The computations do not follow in a straightforward manner. For example, to compute T_m it is first necessary to find factors (a), (b), (c), (h), (d), (e), and (f). Then factor (f) divided by factor (d) gives $T_m - T_L$ and since T_L is known T_m is determined by adding T_L to the quotient (f)/(d) which is $T_m - T_L$. All this must be done before one of the temperature differences may be calculated. Note also that there is a different factor (b) for use when centigrade or fahrenheit temperatures are going to be used. To prevent confusion the factor not used should be crossed out.

PROBLEM SOLUTION

Nomographs for use in problems involving immiscible fluids are the same as those used for miscible fluids. The computations indicate that a condenser containing 1,500 sq. ft. of surface using 637 $\frac{3}{4}$ -in. O.D. \times No. 16 BWG tubes 12 ft. long will satisfy the requirements of the specifications. It will be noticed that the sum of the factors in the column for condensing is greater than 1. This was left this way for purposes of discussion. To find the length required to make this sum equal to 1, multiply 1.012×8 ft., the chosen length, and obtain about 8.1 ft. This leaves 3.9 ft. for subcooling which is still enough to keep the subcooling factor less than 1. The alignment charts for the mechanical design factor cannot of course be read with the accuracy indicated by the figures on the computation sheet but the $4/3$ power is easily found on

the slide rule and this may be done if accuracy is desired. However, that 637 tubes is the right number rather than the next standard smaller number of 532¹ is unmistakable even if the alignment charts are read with only casual accuracy. If 532 tubes were tried and the condensing length were maintained at 8 ft. the condensing factor (sum of products) would be 1.267. This is too far from 1.0 to permit the use of this smaller number of tubes but in general this factor could be allowed to go as high as 1.1 without too much concern about performance of the heat exchanger.

EFFECT OF TUBE SIZE

In the problems solved in this series only tubes $\frac{3}{4}$ in. O.D. or larger have been used. Reason, there is a table of tube counts available¹ and this table shows no tube counts for tubes smaller than $\frac{3}{4}$ in. O.D. In the chemical industry the use of $\frac{3}{4}$ in. O.D. tubes is quite common and it would be of interest to point out the advantages of using this size in the problem of this article. A standard 25 in. I.D. shell will contain 745 $\frac{3}{4}$ -in. O.D. tubes on $\frac{11}{16}$ in. triangular pitch. Using this tube count and 0.495 in. I.D. (16 BWG) the "sum of products" is 1 for condensing using 8.75 ft. for length and 1.026 for subcooling using 3.25 ft. for length. The latter summation is close enough to 1 to say that this condenser will be satisfactory. The area would be 1,470 sq. ft. compared with 1,500 sq. ft. using $\frac{1}{2}$ in. O.D. tubes, but the shell would be smaller, flanges would be smaller, total weight of tubes less, total metal to be drilled out of tube sheet less, and it would cost less. In general, the use of smaller tubes results in more economical design.

PRESSURE DROP

In condensers it will be noted that pressure drop on the condensing side rarely influences the design. In the problem presented in this article the pressure drop is less than 0.05 psi. whereas the allowable pressure drop was 0.25 psi. The limitation placed on tube length was responsible for the low pressure drop existing in this case.

TEMPERATURE APPROACH

It is not possible to make a generalization as to proper temperature ap-

proaches to use for all conditions at the extremities of a condenser-subcooler.

However, for purposes of assisting the inexperienced designer, we may suggest an approach on the hot end of not less than 20 deg. C. (36 deg. F.) and on the cold end of not less than 5 deg. C. (9 deg. F.). By resorting to Eq. V-13, we can readily estimate the minimum extra tube length required to subcool the condensate to within 4 deg., 3 deg., or 2 deg. C. of the inlet cooling water. The only variables involved are $t_m - t_L$, ΔT_e , and L_B . If the quotient $(t_m - t_L) / \Delta T_e \times L_B^{1/3}$ remains constant then we have a valid design. For the 5 deg. C. approach we had $t_m - t_L = 65 - 35 = 30$; $\Delta T_e = 34 + 5/2 = 19.5$; and $L_B = 3.9$ ft. For 4 deg., 3 deg. and 2 deg. C. approach, the following table records the values for these functions:

$(t_m - t_L)$	5	4	3	2
$(t_m - t_L)$	30	31	32	33
ΔT_e	19.5	19.0	18.5	18
L_B	3.9	5.5	7.9	11

The quantity L_B is calculated from the equation:

$$L_B = [(t_m - t_L) / 1.23 \Delta T_e]^{1/3}$$

which is obtained from the requirement that the quotient

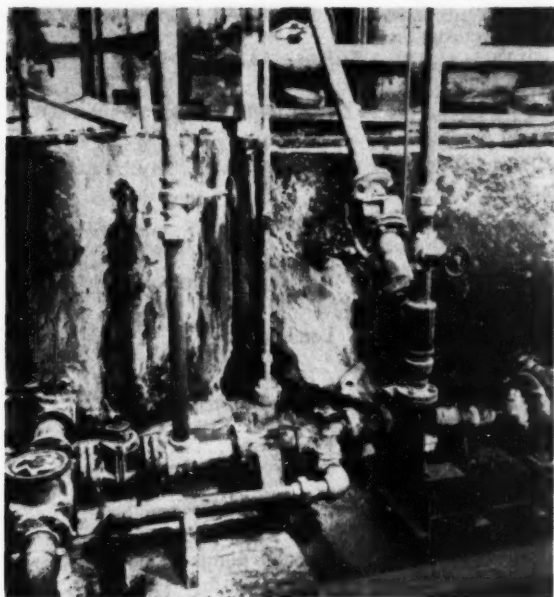
$$t_m - t_L / \Delta T_e L_B^{1/3} = 1.23$$

the value found for 5 deg. approach. Thus it may be seen that to cool the condensate from 65 deg. C. to 32 deg. C. would require 11 ft. of tube length or $11/3.9 = 2.82$ times the length to cool it to 35 deg. C. There will be instances when the designer may find that 5 deg. C. approach at the cold end is not justified and a calculation similar to that above will indicate the decrease in length resulting from an increase in temperature of the condensate.

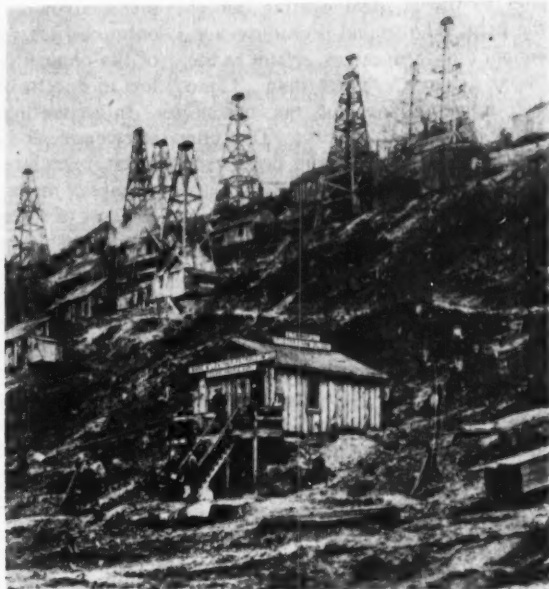
The above study of the effect of the variation of a few of the functions in the design equation illustrates another advantage of the shortcut method for heat exchanger design. Since all of the variables are presented in their net relationship to each other, the effect of variations in either individual or groups of functions is readily calculated.

REFERENCE

1. Kern, "Process Heat Transfer," Table 9, p. 842, McGraw-Hill Book Co., New York (1950).



DETERIORATION



OBsolescence

Evaluate Your Depreciation Charges

Here, in concise form, is the basic background you should have on depreciation, deterioration and obsolescence. This useful knowledge can be applied to specific situations in particular plants.

A. M. HARTOGENSIS and H. D. ALLEN

From the very first day capital assets are bought they begin to lose value. This continuous loss represents one of the costs of being in business. It is also one of the costs which every firm tries to keep consistently lower than that of its competitors. It's called depreciation.

The word depreciation is a common enough business term. But despite its frequent usage, it is often less clearly understood than it should be for the most effective business management.

For example, some managers pay little or no attention to depreciation as it affects their operating decisions. Others rely entirely on someone else's ideas of how it should be treated, without really knowing the basis for

such views. Still others do not realize how their policies and actions can affect depreciation.

And these are not theoretical, "arm-chair" considerations. They are integral parts of sound planning. In a competitive industrial climate, you must deal with depreciation on a reasoned, analytical basis, not by guess.

WHAT IS DEPRECIATION?

Buildings and equipment wear out through use, or as a result of the passage of time. The original cost of each long-lived item, less its scrap or salvage value, if any, is the cost of all the years of its useful service or of its output over those years. For example, a pump that cost \$3,100 may be operated ten years and then sold as scrap for \$100. It has thus depreciated a total of \$3,000 in value, and the depreciation cost, per year is \$300.

However, the life of most capital items cannot be measured conven-

iently in terms of units of use or production. Therefore, it's customary to estimate their probable life in years and to consider depreciation cost as so much per year or per month.

You might operate the pump referred to above for two years and then sell it for \$1,700. In this case, the depreciation cost would be \$1,400 in total, or \$700 a year. On the other hand, you might operate it for eight years and then sell it for \$100 scrap value. In this case, the depreciation cost would be \$3,000, or \$375 a year.

Obviously, the cost of depreciation depends in part on "policy"; that is, how well the property is maintained and how long it's kept before it's disposed of.

To understand depreciation clearly it's necessary to determine what factors cause values to decline. To do this, you must recognize that depreciation involves two main influences.

The first is deterioration, which re-

lates to the physical wearing out of the item. The second is obsolescence, which, broadly speaking, relates to the "up-to-dateness" of the item. These two influences do not run concurrently in any given case. The one which is operating at the faster rate governs.

THE DETERIORATION FACTOR

This phase of depreciation is the one regularly recognized in normal accounting practice. It is caused by such actions as corrosion, abrasion, concussion, vibration, heavy usage, accidents, and the like. Eventually an item usually becomes so old and worn that new parts can no longer be retained satisfactorily in the old body. At this point maintenance becomes so expensive that it is cheaper to replace the article completely.

But surfaces can be repainted, bearings and bushings replaced, alloy parts installed, flooring repaired, and so on, to correct and lessen the effects of deterioration. Experience has shown that when facilities are taken care of and kept in good operating condition for the work they are regularly called upon to perform they maintain close to original operating efficiency for the greater part of their useful lives.

There are numerous buildings still in use that were built several hundred years ago. Many stills and furnaces have been in operation for 30 years. Some types of standard production equipment like certain filter presses or textile machinery are still producing today after 40 or 50 years of steady service.

Some facilities, therefore, depreciate very little from the effects of wear and tear. Yet they still have to be replaced if the manufacturer is to remain competitive. What, then, is the reason behind this fact? The answer to that question lies in the effects of obsolescence.

THE OBsolescence FACTOR

Buildings, process equipment, and other capital items sometimes lose rapidly a large part of their original value for reasons other than wearing out. For example, because of a change in design, a reactor may become outdated. Similarly, a centrifugal may be superseded by a new model with much higher production capacity.

New developments in process may also take place. If an item being de-

preciated on a 10-year basis is thus outmoded after six years, four-tenths of the original cost will be lost. This loss is due to obsolescence.

In accounting for depreciation, obsolescence is generally considered when it can be estimated reliably. For example, many companies amortize the cost of special equipment—which would last 10 years or more—over a three- or four-year period because experience has shown that these items will be outdated in that period.

In cases of this sort, the depreciation cost carried on the books is clearly a combination allowance, including both deterioration and obsolescence. But the line between the two is often vague.

Finally, new developments and improvements in manufacturing processes, machinery and equipment also result in obsolescence. However, in such cases, the loss may not be known or measurable in advance. It is actually a comparative loss, because although the old equipment will continue to produce at the old cost, new equipment may produce at a sufficiently lower cost to pay for the replacement in a relatively short time.

ACCOUNTING FOR DEPRECIATION

Since depreciation represents the cost of using capital assets in operation or production, these costs should be reflected in the accounts by monthly entries, charging depreciation expense and crediting a reserve for depreciation. Usually a single expense account and a single reserve account will suffice for handling both deterioration and obsolescence factors.

All but very small companies, however, should set up separate accounts showing the depreciation of the assets of production, sales, general office and research and development. In this way you can account separately for production costs, selling expenses, and administrative and general expenses. Separate accounts can also be informative for depreciation of buildings, machinery and other equipment.

The amount to be depreciated over the life of an asset is the cost of that asset (including installation), less the estimated salvage or scrap value. However, except where it might be substantial, salvage or scrap value is often ignored in accounting for depreciation.

It is usually more practicable to

TYPICAL USEFUL LIVES—

Sulfuric Acid	Years
Acid pumps	7
Burners	10
Converters	14
Air compressors	15
Lead tanks	20
Acetic Acid	
Blow cases	3
Lead condensers	6
Vacuum pumps	7
Fractionating columns	8
Copper condensers	10
Wood tanks	25
Carbide & Carbon Products	
Ammonia columns	6
Steam-jacketed kettles....	6
Digesters	10
Crushers	12
Coke ovens	17
Briquetting machines	18
Electric furnaces	20
Electrochemicals	
Corrosive liquor pumps	10
Electrolytic cells	15
Crystallizers	15
Dust collectors	15
Steel tanks	15
Vacuum dryers	20
Steel filter presses.....	20
Mixers	20

—INCOME TAX APPROVED

Alkalies	Years
Caustic soda evaporators..	17
Cast iron retorts.....	20
Lime kilns	22
Carbonating towers	33
Carbonic Gas Products	
Heat exchangers	15
Absorbers	16
Gas scrubbers	16
Air compressors	22
Soaps	
Fatty acid stills.....	10
Spraying equipment	10
Mixers	12
Ejectors	15
Carton-filling machines...	15
Soap pumps	15
Chip dryers	15
Soap plodders	15
Soap kettles	25
Oil Refining	
Cracking stills	15
Heat exchangers	20
Pumps	20
Steam stills	20
Vacuum stills	20
Agitators	25
Condensers	25
Wax plants	25
Storage tanks	30

compute and use composite depreciation rates on groups of assets—such as buildings and general equipment classifications—than to use individual rates on each item. But it may be necessary to make a depreciation “study” on individual items in order to develop the group rates. If some items are amortized over a comparatively short period, say two or three years, in order to provide for their obsolescence, these items should be segregated into a separate group.

A schedule of depreciation can be set up for each group, with headings as follows:

Item	Expected Life, Yr.	Orig. Cost (in Place)	Annual Depreciation
Filter Press	20	\$10,000	\$500

Thus, annual depreciation in dollars is the amount of original cost divided by expected life, regardless of the age of the item at the time of the study. The age at time of study multiplied by the annual depreciation is the amount which should be in the depreciation reserve at any given time.

For example: when the age of the filter press is eight years and the annual depreciation charge is \$500, the depreciation reserve should show \$4,000 ($8 \times \$500 = \$4,000$). The total for the group in the annual-depreciation column, divided by the total in the original-cost column, expressed as a percentage, is the composite rate of annual depreciation for the group. One-twelfth of this amount should be recorded monthly.

To illustrate:

Item	Expected Life, Yrs.	Orig. Cost (in Place)	Annual Depreciation
A	20	\$10,000	\$500
B	30	12,000	400
C	10	9,000	900
D	5	2,000	400
E	25	15,000	600
Total	—	\$48,000	\$2,800

$\$2,800 \times 100 \div \$48,000 = 5.8$ percent composite annual depreciation rate. $5.8 \div 12 = 0.48$ percent composite monthly depreciation rate.

The fixed capital asset accounts on the books should also be subdivided in accordance with the composite depreciation groups established. Because of the writing off of property and the purchase of new equipment from time to time, the amounts of original cost in each group may change monthly. But the composite rate, when once established, may be applied to the new balance in the group account until such a time as a new composite rate is established.

Perhaps every three to five years, depending on how fast one adds to or replaces the plant, a new schedule of depreciation should be prepared. From it, new composite group rates of depreciation should be calculated. It may be advisable to calculate new depreciation rates for one group and not for other groups when there has been considerable change in the first group or when it is decided to change your company's over-all depreciation policy.

In any case, it should be noted that it's usually considered preferable to record in the accounts the same amounts of depreciation as are allowed in calculating Federal income taxes. This procedure avoids having to maintain a separate set of reconciling figures.

USE AS AN INCOME TAX DEDUCTION

In computing net taxable income, Federal and State laws permit the deduction of reasonable amounts for the exhaustion and wear (depreciation) of property used in trade and business or held for the production of income. It is highly desirable to take the maximum allowable deduction.

Bulletin F, issued by the Bureau of Internal Revenue, shows the estimated useful lives and rates of depreciation for many classes of industrial property. These lives and rates are acceptable as a guide or starting point for calculating depreciation for income tax deductions.

But experience, as borne out by records, provides the soundest basis for estimating probable service life of equipment. This experience may prove it necessary or advisable to change the rates provided in Bulletin F.

In this connection, the Commissioner of Internal Revenue, on May 12, 1953, announced that the Bureau will not quibble over such rates and that it will not change allowances once they are established unless “there is a clear and convincing basis for a change.” The burden of proof is on the producer, not government. Typical accepted useful lives of various equipment in the chemical process industries are shown in the accompanying tables.

Allowances for depreciation are in addition to the allowable deductions of amounts spent for repairs. Property kept in good repair continues to depreciate, but its useful life may be

prolonged and a lower rate of depreciation may be applicable.

In general, however, major repairs which renew the life and retard the deterioration of property may be disallowed as deductible repair expense. Consequently, such expenditures might properly be charged to the depreciation reserve account since they reduce the depreciation in property.

No further deduction for depreciation may be made after the full cost of property has been deducted. The item is then said to be "fully depreciated" and is carried on the books at zero value.

When depreciation is calculated on a group basis, it refers to the group and not to individual items within the group. But it is probable that a lower rate of depreciation will have to be used when the group reserve approaches 70-80 percent of the original cost of the combined items—unless it can be shown that a large part of the property in the group is about to be retired from service.

DOESN'T PROVIDE FOR REPLACEMENT

There is considerable controversy over whether depreciation should provide for replacement of property, or whether it should provide only for recovery of the original cost. If price levels didn't change during the life of the property, and if each item were replaced with an exact duplicate, there would be no argument.

But prices do fluctuate and major items of property are seldom replaced "in kind." These facts are at the core of the controversy.

Currently, generally accepted principles of accounting and existing income tax provisions are based on recovery of cost, not provision for replacement. When prices rise, insufficient funds are provided for replacement. Conversely, when they fall, excess funds are available.

Since most prices have been rising for many years there is considerable sentiment in favor of providing higher depreciation allowances, at least as an income tax deduction. This has, of course, been achieved on a limited scale in cases of certified emergency defense facilities of uncertain permanent usefulness, through the issuance of Necessity Certificates which permit accelerated amortization on a specified portion of the investment for tax purposes.

But no practicable depreciation formula will permit recovery of full replacement cost over the life of an asset during a period of rising prices. Price rises can't be predicted and replacement prices can't be known until the time comes for actual replacement.

Moreover, many buildings and items of equipment are either not replaced at all, or are replaced with a different size or kind of item. Therefore, despite its inequities, original cost has remained as the basis of depreciation cost finding for accounting and income tax purposes.

WHEN TO REPLACE EQUIPMENT

Even though a piece of equipment is still in good working order, it may be worth while to replace it with a newer one. Among the major advantages may be greater capacity, lower maintenance cost, lower direct labor cost.

Offsetting these savings are increased depreciation, increased property taxes and insurance rates and increased interest on the additional investment required. In addition, there may be a problem of providing the necessary capital with which to make the purchase.

A study of cost factors usually provides an answer in the form of savings (or loss) of so much per year per dollar of added investment.

If the saving indicated is, for example, 20 cents a year on the dollar, it is equivalent to a return of (interest rate of) 20 percent. To state this another way, the investment will pay for itself in five years. Since investment capital is usually limited, it should be concentrated, if possible, on items which will repay cash outlay in the shortest time.

When analysis shows that it would pay to replace a piece of equipment, that piece is said to be obsolescent. Nevertheless, financial provision or provision in the accounts is seldom made for this type of economic obsolescence.

Several books on engineering economics provide formulas for calculating whether equipment is obsolescent. The subject can be complicated, though, and is greatly dependent upon experience and circumstances in your particular field.

In any case, depreciation cost used in a study of the replacement of

equipment is not future depreciation or the undepreciated value of the old equipment. Rather, it's the amount of depreciation of the new equipment over the period when the old equipment might be continued in service if it were not replaced.

For example, if a condenser has an expected life of 15 years, consider the case for replacing it after 12 years. The depreciation cost to be used in replacement calculations will be the cost of three years' depreciation on the new condenser. Hence, if the proposed new condenser has a 10-year life and a \$20,000 price tag, \$6,000 (3 years \times \$2,000) is the depreciation cost and the undepreciated value of the old piece of equipment is disregarded.

USE DEPRECIATION TO SET PRICES

Since all competitive sellers have costs and none can continue to sell below cost for very long, costs always influence competitive prices. When business is good and demand is greater than supply—a sellers' market—even the seller with the highest cost finds some customers.

But when business is poor and supply exceeds demand, the costs of the more efficient sellers tend to set prices and high-cost producers tend to lose their markets.

In calculating selling prices depreciation costs should usually be computed from present replacement value of assets, not on actual cost as for accounting and tax purposes. Competitors have acquired their property and equipment at different times and at different price levels. With respect to depreciation, the highest cost producer bought his equipment at high prices and the lowest cost competitor at low prices, other factors being equal.

Therefore, in a sellers' market with rising prices, current high prices for equipment tend to govern the costs of the high-cost producer; in a buyers' market with falling prices, current low equipment prices tend to control the costs of low-cost producers.

These are the competitors whose costs and prices strongly influence prices in the two different types of market conditions. Consequently, replacement values are a better basis for depreciation than initial purchase cost when considering competitive price policies.

Next Time Use Capitalized Costs

... a simple, sound basis for comparing costs of alternatives on a common denominator basis. It accounts for differences in first cost, operating expense, deferred costs, obsolescence and salvage value.

F. C. JELEN

Whenever there is a choice of different materials or methods in the design or operation of a chemical plant, we must compare the costs of the various alternatives in order to decide which is the most economical. Purpose of this article is to develop certain mathematical relationships involved in the cost factors so that this comparison will be on a sound economic basis. These relationships are universally valid for all engineering problems, as they are applicable to any problem presenting a choice of capitalization costs.

That article or system having the lowest capitalized cost is the most economical.

To comprehend the basis for this statement we must understand the concept of capitalized cost. The term "capitalized cost" is used to designate the first cost plus the present value of an indefinite number of renewals. It is the cost on a perpetual basis, or the cost if the article or process were in use forever.

We can illustrate the full significance of this concept by a simple numerical example:

Condenser tubes cost \$10,000 installed and last 6 years. Assume solely for the purpose of this article that money is worth 4 percent. The capitalized cost of the tubes is \$47,693, as the following reasoning will verify. The capitalized cost of \$47,693 less the original cost of \$10,000 leaves \$37,693 in excess. This \$37,693 at 4

percent compound interest for 6 years will equal \$47,693:

$$(\$37,693)(1.04)^6 = \$47,693 \quad (1)$$

so that at the end of 6 years when the tubes must be replaced we will have available \$10,000 for the replacement plus \$37,693 left over, which in turn will equal \$47,693 at the end of another 6 years.

In this example \$47,693, the capitalized cost of the tubes, is exactly that sum which will provide for the first cost of the tubes plus an indefinite number of renewals.

At the time of installation of the tubes we need a capital outlay of only \$10,000, but if the tubes are to be perpetuated we must have available \$37,693 at 4 percent per year increment. This \$37,693 need not be available as cash and probably would not be so available; however, it is only the existence of this \$37,693 which perpetuates the tubes. The capitalized cost of \$47,693 is useful principally in comparing alternative choices.

Even if the tubes were not to be perpetuated (suppose they were part of a process which is abandoned at the end of 6 years), the capitalized cost of the tubes is still \$47,693. This

is so because at the end of the life of the tubes, the capitalized cost is restored.

THE SIMPLEST CASE

Here is a mathematical derivation for capitalized cost for the simplest case. Other factors are included later as additional terms in the expression.

Suppose an article costs C , that it lasts m years, that money is worth i per year expressed as a decimal, and that K_1 is the capitalized cost. Referring to Eq. (1) we see that the capitalized cost minus the first cost, all at compound interest for m years at rate i , must restore the capitalized cost. Algebraically,

$$(K_1 - C)(1 + i)^m = K_1$$

$$K_1 = C(1 + i)^m / (1 + i)^m - 1$$

or

$$K_1 = CF_m \quad (2)$$

where

$$F_m = (1 + i)^m / (1 + i)^m - 1$$

and K_1 = capitalized cost, C = first cost, m = life of article in years and i = interest rate per year. Values of F_m for various rates i have been calculated and are given in Table I.

With Eq. (2) we can solve several

NOMENCLATURE

- A** Annual expense, dollars per year
C Initial cost of a facility, dollars
D Cost of abandonment, dollars

$$F_m = \frac{(1 + i)^m}{(1 + i)^m - 1}$$

$$G_m = \frac{1}{(1 + i)^m - 1}$$

- G** Deferred cost factor
H Deferred cost, dollars
i Interest rate, decimal per year
K₁ Capitalized cost of owning a facility, dollars
K₂ Capitalized cost of operating charges, dollars
K₃ Capitalized cost of owning and operating a facility, dollars
K₄ Capitalized cost of salvage value, dollars
K₅ Capitalized cost of a deferred cost

- occurring at regular intervals, dollars
K₆ Capitalized cost of a deferred cost where the last occurrence of the deferred cost is neglected, dollars
K₇ Capitalized cost of a deferred cost where the last period is irregular, dollars
K₈ Capitalized cost of a single deferred cost, dollars
K₉ Capitalized cost of a nonrecurring cost, dollars
L Salvage value, dollars
M Net debit charges for operation, dollars per year
m Useful life of a facility, years
N Initial nonrecurring cost, dollars
p Period over which a cost is deferred, years
q Period from occurrence of last deferred cost to end of useful life, years
S Net credit charges for operation, dollars per year
t Age of a facility at abandonment, years

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simple problems. A few representative types follow:

1. Anodes for an electrochemical process cost \$15,000 and last 2 years. How much can we spend for special impregnated anodes which will last 7 years, with money worth 4 percent?

For the two to be economically equal the capitalized costs must be equal. Denoting the terms for impregnated anodes with primes, we have

$$\begin{aligned} CF_7 &= C'F_7 \\ (15,000)(13.26) &= C'(4.166) \\ C' &= \$47,740 \end{aligned}$$

Therefore, we can afford anything less than \$47,740 for the impregnated anodes.

2. A new storage tank would cost \$8,000 and would last 12 years. How much can we spend now to patch up a worn-out storage tank to extend its life 3 years, assuming money to be worth 4 percent?

The capitalized cost for a new storage tank would be

$$\begin{aligned} K_1 &= CF_m = 8,000 F_{12} \\ &= (8,000)(2.664) = \$21,312 \end{aligned}$$

The capitalized cost for patching the existing tank must not exceed this figure:

$$\begin{aligned} \$21,312 &= C'F_3 = C'(9.006) \\ C' &= \$2,366 \end{aligned}$$

This is the most we can spend for patching the present tank.

Note that the difference between the capitalized cost of a new tank, \$21,312, and the cost of patching the existing tank, \$2,366, is \$18,946; and that \$18,946 at compound interest for 3 years, the life of the patched tank, is

$$(18,946)(1.04)^3 = \$21,312$$

which is exactly the capitalized cost of a new tank.

3. A floor costs \$5,000 and lasts 2 years. If made from a more resistant material it would cost \$16,500. How long would such a floor have to last to justify its installation if money is worth 4 percent?

$$\begin{aligned} CF_m &= C'F_m' \\ 5,000 F_2 &= 16,500 F_m' \\ (5,000)(13.26) &= 16,500 F_m' \\ F_m' &= 4.018 \end{aligned}$$

Referring to Table I we find that $F_7 = 4.166$ and $F_8 = 3.713$. Thus, the more resistant floor would have to last between 7 and 8 years to be justified.

Frequently the application of Eq. (2) will require the summation of two or more terms:

$$K_1 = C'F_m' + C''F_m'' + C'''F_m''' \text{ etc.} \quad (3)$$

Eq. (3) is a generalized form of Eq. (2) and is merely a mathematical expression of the statement that in a complicated system the capitalized cost is the sum of the capitalized costs comprising the system.

INCLUSION OF ANNUAL CHARGES

Eq. (2) and its generalized form Eq. (3) are sufficient to solve many problems in capitalized cost, but we can make them much more extensive by inclusion of certain annual charges. These annual charges can be a debit or a credit.

Let M = net debit charges per year and S = net credit charges per year. M will usually be the sum of a number of yearly costs such as labor, supervision, material, power, etc. S likewise will usually be the sum of a number of yearly savings, such as increased production, value of a better product, savings due to better heat transfer, etc.

In more advanced problems in capitalized cost where M and S will be different for alternative systems we must incorporate M and S in the capitalized cost. The difference between the two, $(M - S)$, can be carried as one term in the analysis.

If a system has a net charge of $(M - S)$ per year, $(M - S)$ can be regarded as equivalent to an article costing $(M - S)$ and lasting one year.

By Eq. (2) the capitalized cost of such an article is

$$K_2 = (M - S)F_1 \quad (4)$$

If Eqs. (2) and (4) are combined, we get

$$K_3 = CF_m + (M - S)F_1 \quad (5)$$

As before, we may have a summation of terms of the form CF_m .

Eq. (5) is sufficient to solve most problems arising in capitalized costs and, with the help of Table I, we can manipulate it with facility. Here are two illustrative examples on the use of Eq. (5):

1. A piece of equipment in a highly corrosive atmosphere lasts 5 years and costs \$10,000. How much can be spent per year on painting if the life is extended to 10 years, assuming money is worth 4 percent?

The capitalized cost without painting is

$$10,000 F_5 = (10,000)(5.615) = \$56,150$$

For the same capitalized cost with painting, by Eq. (5),

Table I



Factors for
Capitalization of
Present Costs

$$\left[\begin{array}{l} F_m \text{ in Equation 2:} \\ K_1 = CF_m \end{array} \right]$$

Table II



Factors for
Capitalization of
Future Costs

$$\left[\begin{array}{l} G_m \text{ in Equation 6:} \\ K_4 = -LG_m \end{array} \right]$$

Table III



Compound
Interest
Factors

$$\left[\begin{array}{l} (1+i)^p \text{ in Equation 10:} \\ K_3 = HF_m / (1+i)^p \end{array} \right]$$

m	2%	3%	4%	5%	6%	7%	8%	10%	12%	14%	16%	18%	20%
1	51.00	34.33	26.00	21.00	17.67	15.29	13.50	11.00	9.333	8.143	7.250	6.556	6.000
2	25.75	17.42	13.26	10.76	9.091	7.901	7.010	5.762	4.931	4.338	3.894	3.548	3.273
3	17.34	11.79	9.006	7.345	6.236	5.445	4.851	4.021	3.470	3.077	2.783	2.555	2.374
4	13.14	8.968	6.886	5.640	4.810	4.218	3.774	3.162	2.744	2.451	2.234	2.065	1.931
5	10.61	7.277	5.615	4.619	3.957	3.484	3.131	2.638	2.312	2.081	1.909	1.776	1.672
6	8.924	6.152	4.799	3.940	3.390	2.997	2.704	2.296	2.027	1.837	1.696	1.584	1.504
7	7.725	5.350	4.166	3.456	2.985	2.651	2.401	2.054	1.826	1.666	1.548	1.453	1.387
8	6.824	4.748	3.713	3.094	2.684	2.392	2.175	1.874	1.677	1.534	1.438	1.362	1.303
9	6.125	4.281	3.362	2.814	2.450	2.193	2.001	1.736	1.564	1.444	1.357	1.291	1.240
10	5.566	3.908	3.083	2.590	2.265	2.034	1.863	1.628	1.475	1.369	1.293	1.236	1.193
11	5.108	3.603	2.854	2.408	2.114	1.905	1.751	1.540	1.404	1.310	1.243	1.193	1.156
12	4.729	3.349	2.664	2.256	1.988	1.799	1.659	1.468	1.345	1.262	1.203	1.159	1.126
13	4.406	3.134	2.504	2.129	1.883	1.709	1.582	1.408	1.297	1.223	1.170	1.132	1.103
14	4.130	2.951	2.367	2.021	1.793	1.634	1.516	1.358	1.257	1.190	1.143	1.109	1.084
15	3.891	2.792	2.249	1.927	1.716	1.569	1.460	1.315	1.224	1.163	1.121	1.091	1.069
16	3.682	2.654	2.146	1.845	1.649	1.512	1.412	1.278	1.195	1.140	1.103	1.076	1.057
17	3.499	2.532	2.055	1.774	1.591	1.463	1.370	1.247	1.171	1.121	1.087	1.064	1.047
18	3.335	2.424	1.975	1.711	1.539	1.420	1.334	1.219	1.149	1.104	1.074	1.054	1.039
19	3.189	2.327	1.904	1.655	1.494	1.382	1.302	1.196	1.131	1.090	1.063	1.045	1.032
20	3.058	2.241	1.840	1.605	1.453	1.349	1.273	1.174	1.116	1.078	1.054	1.038	1.027
21	2.939	2.162	1.782	1.560	1.417	1.318	1.248	1.156	1.102	1.068	1.046	1.032	1.022
22	2.832	2.092	1.730	1.519	1.384	1.292	1.225	1.140	1.090	1.059	1.040	1.027	1.018
23	2.733	2.027	1.683	1.483	1.355	1.267	1.205	1.126	1.080	1.052	1.034	1.023	1.015
24	2.644	1.968	1.640	1.449	1.328	1.246	1.187	1.113	1.071	1.045	1.029	1.019	1.013
25	2.561	1.914	1.600	1.419	1.304	1.226	1.171	1.102	1.063	1.039	1.025	1.016	1.011
30	2.232	1.701	1.446	1.301	1.211	1.151	1.110	1.061	1.035	1.020	1.012	1.007	1.004
35	2.000	1.551	1.339	1.221	1.150	1.103	1.073	1.037	1.019	1.010	1.006	1.003	1.002
40	1.828	1.442	1.263	1.166	1.108	1.072	1.048	1.023	1.011	1.006	1.003	1.001	1.001
45	1.696	1.360	1.207	1.125	1.078	1.050	1.032	1.014	1.006	1.003	1.001	1.001	1.000
50	1.591	1.326	1.164	1.096	1.057	1.035	1.022	1.009	1.004	1.001	1.001	1.000	1.000

m	2%	3%	4%	5%	6%	7%	8%	10%	12%	14%	16%	18%	20%
1	50.00	33.33	25.00	20.00	16.67	14.29	12.50	10.00	8.333	7.143	6.250	5.556	5.000
2	27.75	16.42	12.25	9.756	8.091	6.897	6.010	4.762	3.931	3.338	2.894	2.548	2.273
3	16.34	10.78	8.009	6.344	5.235	4.444	3.850	3.021	2.470	2.077	1.783	1.555	1.374
4	12.13	7.967	5.887	4.640	3.810	3.217	2.774	2.155	1.744	1.451	1.234	1.065	0.9314
5	9.608	6.279	4.616	3.620	2.957	2.484	2.082	1.638	1.312	1.081	0.9088	0.7765	0.6719
6	7.926	5.153	3.760	2.940	2.389	1.997	1.704	1.296	1.027	0.8368	0.6962	0.5844	0.5035
7	6.725	4.350	3.185	2.450	1.985	1.651	1.401	1.084	0.8260	0.6656	0.5476	0.4576	0.3871
8	5.825	3.749	2.713	2.094	1.684	1.392	1.175	0.8744	0.6775	0.5379	0.4380	0.3625	0.3030
9	5.126	3.281	2.362	1.814	1.450	1.193	1.001	0.7364	0.5640	0.4441	0.3568	0.2911	0.2404
10	4.566	2.908	2.082	1.590	1.264	1.034	0.8629	0.6275	0.4749	0.3694	0.3000	0.2362	0.1926
11	4.109	2.603	1.854	1.408	1.113	0.9051	0.7510	0.5396	0.4035	0.3100	0.2429	0.1932	0.1555
12	3.728	2.349	1.664	1.257	0.9879	0.7986	0.6587	0.4676	0.3453	0.2619	0.2026	0.1590	0.1263
13	3.406	2.134	1.504	1.129	0.8827	0.7093	0.5815	0.4078	0.2973	0.2226	0.1699	0.1316	0.1031
14	3.130	1.951	1.367	1.020	0.7931	0.6335	0.5162	0.3575	0.2573	0.1901	0.1431	0.1093	0.08446
15	2.891	1.792	1.249	0.9269	0.7160	0.5688	0.4604	0.3147	0.2235	0.1629	0.1210	0.09070	0.06925
16	2.682	1.654	1.146	0.8454	0.6492	0.5123	0.4122	0.2782	0.1949	0.1401	0.1026	0.07617	0.05718
17	2.499	1.532	1.055	0.7740	0.5907	0.4632	0.3704	0.2466	0.1705	0.1208	0.08720	0.06381	0.04720
18	2.335	1.424	0.9749	0.7109	0.5393	0.4202	0.3338	0.2193	0.1495	0.1044	0.07428	0.05355	0.03903
19	2.189	1.327	0.9035	0.6549	0.4937	0.3822	0.3016	0.1955	0.1314	0.09045	0.06338	0.04502	0.03231
20	2.058	1.241	0.8396	0.6049	0.5531	0.3485	0.2732	0.1746	0.1157	0.07847	0.05417	0.03789	0.02678
21	1.939	1.162	0.7820	0.5599	0.4167	0.3184	0.2479	0.1592	0.1020	0.06818	0.04635	0.03192	0.02222
22	1.832	1.092	0.7300	0.5194	0.3841	0.2915	0.2254	0.1401	0.09009	0.05981	0.03970	0.02692	0.01845
23	1.733	1.027	0.6827	0.4828	0.3547	0.2673	0.2053	0.1257	0.07967	0.05165	0.03404	0.02272	0.01533
24	1.644	0.9682	0.6397	0.4494	0.3280	0.2456	0.1872	0.1130	0.07053	0.04502	0.02921	0.01919	0.01274
25	1.561	0.9142	0.6003	0.4190	0.3038	0.2259	0.1710	0.1017	0.06260	0.03927	0.02508	0.01622	0.01059
30	1.232	0.7006	0.4457	0.3010	0.2108	0.1512	0.1103	0.06079	0.03453	0.02002	0.01162	0.007024	0.004231
35	1.000	0.5513	0.3394	0.2214	0.1496	0.1033	0.07254	0.03690	0.01931	0.01030	0.005577	0.003058	0.001696
40	0.8278	0.4421	0.2631	0.1656	0.1077	0.07156	0.04825	0.02259	0.01086	0.005323	0.002947	0.001334	0.0006808
45	0.6955	0.3666	0.2096	0.1252	0.07834	0.05000	0.03234	0.01391	0.006135	0.002757	0.001259	0.0005829	0.0002735
50	0.5912	0.2955	0.1638	0.09654	0.05741	0.03514	0.02179	0.008592	0.003472	0.001430	0.0005989	0.0002547	0.0001099

p	2%	3%	4%	5%	6%	7%	8%	10%	12%	14%	16%	18%	20%
1	1.0200	1.0300	1.0400	1.0500	1.0600	1.0700	1.0800	1.1000	1.1200	1.1400	1.1600	1.1800	1.2000
2	1.0404	1.0609	1.0816	1.1025	1.1236	1.1449	1.1664	1.2100	1.2544	1.2996	1.3456	1.3924	1.4400
3	1.0612	1.0927	1.1249	1.1576	1.1910	1.2250	1.2597	1.3310	1.4049	1.4815	1.5609	1.6430	1.7280
4	1.0824	1.1255	1.1699	1.2155	1.2625	1.3108	1.3605	1.4641	1.5735	1.6890	1.8106	1.9388	2.0736
5	1.1041	1.1593	1.2167	1.2763	1.3382	1.4026	1.4693	1.6105	1.7623	1.9254	2.1003	2.2878	2.4883
6	1.1262	1.1941	1.2653	1.3401	1.4185	1.5007	1.5869	1.7716	1.9738	2.1950	2.4364	2.6996	2.9860
7	1.1487	1.2299	1.3159	1.4071	1.5036	1.6058	1.7138	1.9487	2.2107	2.5023	2.8252	3.1855	3.5832
8	1.1717	1.2668	1.3686	1.4775	1.5938	1.7182	1.8509	2.1436	2.4760	2.8502	3.2784	3.7589	4.2998
9	1.1951	1.3048	1.4233	1.5513	1.6895	1.8385	1.9990	2.3579	2.7731	3.2520	3.8030	4.4355	5.1598
10	1.2190	1.3439	1.4802	1.6289	1.7908	1.9672	2.1589	2.6037	3.1058	3.7072	4.4114	5.2334	6.1917
11	1.2434	1.3842	1.5395	1.7103	1.8983	2.1049	2.3316	2.8531	3.4785	4.2262	5.1173	6.1759	7.4301
12	1.2682	1.4258	1.6010	1.7959	2.0122	2.2522	2.5182	3.1394	3.8960	4.8179	5.9360	7.2876	8.9161
13	1.2936	1.4685	1.6651	1.8856	2.1329	2.4098	2.7196	3.4523	4.3635	5.4924	6.8588	8.5994	10.699
14	1.3195	1.5126	1.7317	1.9799	2.2609	2.5785	2.9375	3.7975	4.8871	6.2514	7.9875	10.147	12.839
15	1.3459	1.5580	1.8009	2.0789	2.3966	2.7590	3.1722	4.1772	5.4736	7.1390	9.2658	11.974	15.407
16	1.3728	1.6047	1.8730	2.1829	2.5404	2.9522	3.4259	4.5950	6.1304	8.1373	10.748	14.129	18.488
17	1.4002	1.6528	1.9479	2.2920	2.6928	3.1588	3.7000	5.0545	6.8960	9.2765	12.468	16.672	22.186
18	1.4282	1.7024	2.0258	2.4066	2.8543	3.3799	3.9060	5.5599	7.6900	10.575	14.462	19.673	26.623
19	1.4568	1.7535	2.1068	2.5270	3.0256	3.6165	4.1857	6.1159	8.6128	12.066	16.777	23.214	31.948
20	1.4859	1.8061	2.1911	2.6533	3.2071	3.8997	4.6610	6.7275	9.6463	13.744	19.461	27.393	38.338
21	1.5157	1.8603	2.2788	2.7860	3.3996	4.1406	5.0338	7.4003	10.804	15.668	22.874	32.324	46.005
22	1.5460	1.9161	2.3699	2.9253	3.6035	4.4304	5.4365	8.1403	12.100	17.861	26.186	38.142	55.206
23	1.5769	1.9736	2.4647	3.0715	3.8197	4.7405	5.8715	8.9543	13.552	20.362	30.376	45.006	66.247
24	1.6084	2.0328	2.5633	3.2251	4.0489	5.0724	6.3412	9.8497	15.179	23.212	35.236	53.109	79.497
25	1.6406	2.0933	2.6658	3.3864	4.2919	5.4274	6.8485	10.835	17.000	26.462	40.874	62.669	95.396
30	1.8114	2.4273	3.2434	4.3219	5.7435	7.6123	10.063	17.449	29.950	50.950	87.044	143.87	237.38
35	1.9999	2.8139	3.9461	5.5190	7.6861	10.677	14.785	28.102	52.800	98.101	180.31	328.09	590.67
40	2.2080	3.2620	4.8010	7.0400	10.286	14.974	21.725	45.259	93.051	188.88	378.72	750.39	1,499.8
45	2.4379	3.7816	5.8412	8.9850	13.765	21.002	31.920	72.891	163.99	363.68	795.44	1,716.7	3,657.2
50	2.6916	4.3839	7.1567	11.467	18.425	29.457	46.902	117.39	289.00	700.24	1,670.7	3,927.3	9,100.4

"These relationships are universally valid for all problems presenting a choice in capitalization costs."

$$56,150 = 10,000 F_{10} + (M-S)F_1$$

$$56,150 = (10,000)(3.083) + (M-S)(26.00)$$

$$(M-S) = \$974$$

That is, we can spend \$974 per year for painting over the 10-year period to extend the life of the equipment from 5 years to 10 years.

2. The tubes in an evaporator cost \$8,000, last 8 years, and require a labor cost of \$2,000 per year for cleaning. We can operate the tubes under essentially nonscaling conditions; this will shorten the life of the tubes but will reduce the labor cost for cleaning to \$500 per year and give an estimated saving of \$1,200 per year because of better heat transfer. If money is worth 4 percent how long must the tubes last under the second set of conditions to permit this method of operation?

For the first set of conditions,

$$K_1 = 8,000 F_8 + (2,000 - 0)F_1$$

$$= (8,000)(3.713) + (2,000)(26.00)$$

$$= \$81,704$$

Using this value of K_1 for the second set of conditions,

$$81,704 = 8,000 F_m + (500 - 1,200)F_1$$

$$81,704 = 8,000 F_m - (700)(26.00)$$

$$F_m = 12.49$$

From Table I, $F_2 = 13.26$ and $F_3 = 9.006$, so that the tubes would have to last between 2 and 3 years for the second set of conditions.

SALVAGE VALUE

If an article has a salvage value L to be realized at the end of m years, the life of the article, this value, like the first cost, is a sum which repeats every m years. If money is worth i per year, at m years hence the capitalized cost of the salvage value will be

$$-L(1+i)^m / [(1+i)^m - 1]$$

We get this directly from Eq. (2); the negative sign denotes that a salvage value is a negative cost.

This expression represents a capitalized cost m years away and we must reduce it to a present value. We do this by multiplying by $1/(1+i)^m$, so that

$$K_s = -L / [(1+i)^m - 1]$$

or

$$K_s = -LG_m \quad (6)$$

where

$$G_m = 1 / [(1+i)^m - 1]$$

Table II contains values of the factor G_m for various rates i .

With the proper sign Eq. (6) in

the broadest sense represents the capitalized cost of a sum L occurring every m years and first starting at the end of m years.

DEFERRED COSTS

Let us consider deferred costs. The simplest case is that in which an overhaul costing H is incurred every p years, first starting at the end of p years. Mathematically these conditions are exactly those which led to Eq. (6), so that the capitalized cost will be

$$K_1 = HG_p \quad (7)$$

Values for the factor G_p are given in Table II.

Eq. (7) is rigorously exact for the conditions expressed, but if H represents an overhaul cost a certain violation will occur in practice. Thus, if an article lasts 20 years and receives an overhaul every 5 years, the 5, 10, and 15-year overhauls will be performed, but the 20-year overhaul would not be necessary because the article would be replaced by a new one at that time. The capitalized cost as computed by Eq. (7) will be too high. We can readily calculate the amount by which it is too high.

Suppose an article lasts m years and receives an overhaul costing H every p years. At the end of m years we will have available for an overhaul the amount H . If this amount is not used, we can regard it as a salvage value whose capitalized cost by Eq. (6) is $-HG_m$. This value should be added to Eq. (7) to arrive at the net capitalized cost. That is,

$$K_2 = HG_p - HG_m$$

$$K_2 = H(G_p - G_m) \quad (8)$$

Eq. (8) is the capitalized cost of an overhaul costing H incurred every p years, first starting at the end of p years, and with cognizance of the practical situation that no overhaul costs are necessary at the expiration of the life of the article, m years.

This equation is rigorously exact only if m is an integral multiple of p , the case of most practical importance. However, we can derive an equation for the case where m is not an integral multiple of p . Such a case would occur, for example, if an article had a life of 19 years and received an overhaul every 5 years. The equation is

$$K_1 = H[G_p - (G_p/G_q)G_m] \quad (9)$$

where q is the number of years from the last overhaul to the expiration of the life of the article, m years. If $p = q$ Eq. (9) reduces to Eq. (8).

Eq. (9) has some generality. It remains valid even if q is greater than p . A special case of some importance arises when a deferred cost H is incurred only once during the life of an article at p years after installation, the life of the article being m years. In this special case,

$$p + q = m$$

$$q = m - p$$

and substitution of numerical values in Eq. (9) will give the correct result.

However, we can make the calculation more easily by reducing Eq. (9), after some manipulation, to

$$K_2 = HF_m / (1+i)^p \quad (10)$$

where K_2 is the capitalized cost of a single deferred cost H occurring at the end of p years for an article lasting m years. We recognize $(1+i)^p$ as the compound interest factor, values for which are tabulated in Table III.

NONRECURRING COSTS

Sometimes we run into nonrecurring first costs, such as the purchase of a patent or similar expenses which occur only once. If N denotes their cost, their capitalized cost K is obviously the same, that is

$$K_2 = N \quad (11)$$

THE COMPLETE EQUATION

By adding Eqs. (6), (7) and (11) to Eq. (5), we get the complete equation for capitalized cost:

$$K = CF_m + (M-S)F_1$$

$$- LG_m + HG_p + N \quad (12)$$

YEARLY COST AND SAVINGS

If the capitalized cost is K , then K represents the cost on a perpetual basis, and the yearly cost A is simply

$$A = iK \quad (13)$$

Thus if two systems have capitalized costs K' and K'' , K' being the larger, the annual savings made by choosing the system K'' is

$$i(K' - K'') \quad (14)$$

We can best understand the significance of the yearly cost as given by Eq. (13) from an example. Suppose a compressor costs \$10,000 and lasts 15 years, with money worth 4 percent. The capitalized cost by Eq. (2) and Table I is:

"Probabilities can be used in adjusting the computed cost to include the possibility of obsolescence."

$$K_1 = 10,000 F_{15} \\ = (10,000)(2.249) = \$22,490$$

The yearly cost by Eq. (13) is

$$A = iK = (0.04)(22,490) = \$899.60$$

POSSIBILITY OF OBsolescence

Frequently we must consider the possibility of obsolescence and decide whether it's worthwhile to choose an article of higher cost having a longer life under circumstances where the article, or the system of which it is a part, may have to be scrapped before the full life of the article can be realized.

If the article will last 10 years but might have to be scrapped at the end of, say, 5 years because of obsolescence, the capitalized cost on the basis of 5 years' life can be computed. If that capitalized cost is still the lowest the article is obviously justified and no further consideration need be given to this case. Usually the situation is more complicated, and though the article may have the lowest capitalized cost if used for its full life, it may not have the lowest capitalized cost if it has to be discarded at an earlier time. It is very desirable to have expressions for capitalized cost which take into account this possibility.

Obsolescence is a chance factor to which we can assign a probability. We use probability values from 0 to 1, where 0 denotes impossibility and 1 certainty. Values in between denote varying degrees of uncertainty; thus a probability of 0.5 denotes a 50-50 chance that an event is as likely to occur as not to occur. We must exercise considerable judgment in the assignment of probabilities of obsolescence.

Here's an example of the manner in which probabilities can be used in adjusting the computed capitalized cost to include the possibility of obsolescence:

A cast-iron pot can be installed for \$10,000 and will last 5 years. An alloy steel pot will cost \$20,000 and will last 20 years. The probability that the pot will have to be abandoned at the end of 5 years because of obsolescence of the process can be taken as 0.15, the probability that it must be abandoned at the end of 10 years 0.35, and the probability that it will

serve its 20 years of life can be taken as 0.50. How does the probability of obsolescence affect the capitalized cost? Money is worth 4 percent.

The sum of the probabilities for all the possibilities must equal unity. Thus, in our case $0.15 + 0.35 + 0.50 = 1.00$, for we are assuming that the pot will either be abandoned in 5 or 10 years or be worn out in 20 years.

The capitalized cost of the cast-iron pot is

$$K = 10,000 F_5 = (10,000)(5.615) = \$56,150$$

The capitalized costs of the alloy steel pot for 5, 10 and 20 years' life respectively are

$$\begin{aligned} 20,000 F_5 &= (20,000)(5.615) = \$112,300 \\ 20,000 F_{10} &= (20,000)(3.083) = \$61,660 \\ 20,000 F_{20} &= (20,000)(1.840) = \$36,800 \end{aligned}$$

If we take each of the above capitalized costs and multiply by its expected probability and add the three terms, we get

$$K = (112,300)(0.15) + (61,660)(0.35) + (36,800)(0.50) = \$56,826$$

Thus, \$56,826 is the probable capitalized cost for the alloy steel pot, whereas \$56,150 is the capitalized cost for the cast-iron pot.

We can do much the same thing when the exact life of an article is doubtful. We can compute the various capitalized costs for a number of different years of life expectancy and multiply each of these capitalized costs by a probability. The sum of the terms will give the probable capitalized cost.

COST OF ABANDONMENT

Frequently we must abandon an article before the end of its useful life. We should have a means of computing the loss, that is, the cost of abandonment. In general, the cost of abandonment is the difference between the capitalized cost and the unexpended value of the capitalized cost at the time of abandonment.

Suppose an article costs \$10,000 and has a life expectancy of 10 years. If money is worth 4 percent what is the cost of abandonment at the end of 7 years?

The capitalized cost of the article based on its full life of 10 years is

$$K_1 = CF_{10} = (10,000)(3.083) = \$30,830$$

The excess of the capitalized cost, \$30,830, over the initial cost, \$10,000, is \$20,830. This \$20,830 at 4 percent compound interest for 7 years

amounts to

$$(20,830)(1.04)^7 = (20,830)(1.3159) = \$27,410$$

The difference between \$30,830, the capitalized cost which would be restored at the end of 10 years, and \$27,410, the amount actually restored at the end of 7 years, is \$3,420, the cost of abandonment in this case.

Expressing the above calculations algebraically, the cost of abandonment D is

$$D = CF_m - (CF_m - C)(1 + i)^t$$

where the symbols have the same meaning as before and t is the time in years when abandonment occurs. With some manipulation we can transform the above equation to

$$D = CF_m/F_{m-t} \quad (15)$$

In Eq. (15) D is the cost of abandonment at the end of t years of an article with a useful life of m years and costing C .

Thus, using Eq. (15) for the example just cited,

$$\begin{aligned} D &= 10,000 F_{10-7} / F_{10} \\ &= (10,000)(3.083) / 9.006 \\ &= \$3,420 \end{aligned}$$

as before.

CONCLUSION

The concept of capitalized cost is a powerful tool in comparing articles or systems having different life expectancies and different first costs or other costs. The principle has been accepted by the American Railway Engineering Association.

The expressions for capitalized cost include the interest on the use of money. The simplest calculations would be made by a straight-line method in which interest is ignored. The two methods will differ to a greater extent as the life of the article m is greater and i is increased.

The rate of interest is the value placed on the use of money. It does not matter whether this money is borrowed or is available from company funds or income. It might even be regarded by some as a profit margin. The exact value to be used for i will obviously be different in different circumstances. The higher is the rate of interest chosen the greater is the premium on the use of increased capitalization, and the formulas for capitalized cost are in accord with this fact.

Thermal Conductivity Chart for Gases

Here is a valuable correlation for thermal conductivity of gases. Knowing specific heat and viscosity, you can easily get the thermal conductivity from the graph.

A. I. JOHNSON and CHEN-JUNG HUANG

In the application of equations for heat transfer coefficients for gases and vapors, the most difficult physical property to evaluate is usually the thermal conductivity. Values of thermal conductivity for vapors are relatively scarce and often inaccurate.

This paper proposes that the conductivity be evaluated from the more readily available specific heat and viscosity of the gas or vapor. A chart is presented for this operation. Furthermore, the group $k(C_p\mu/k)^{1/3}$, which appears in the Sieder-Tate correlation and others, may be evaluated quickly from the chart.

PREPARING THE CHART

This chart is based on the well known correlation between the ratio of the specific heats K , and the Prandtl number²:

$$\frac{C_p\mu}{k} = \frac{4}{9 - 5/K}$$

This equation is rearranged as:

$$k = \frac{(9 - 5/K) C_p\mu}{4}$$

When values of k , with units Btu./(hr.) (sq. ft.) (deg. F./ft.), were plotted against $C_p\mu'$ —where C_p has units Btu./(lb.) (deg. F.) and μ' had the practical units of centipoises—straight lines were obtained for three groups of chemicals:

Group A, compounds containing less than 4 atoms, $k = 3.45 C_p\mu'$

Group B, compounds containing more than 4 atoms, $k = 2.86 C_p\mu'$

Group C, water, hydrogen sulphide, $k = 2.56 C_p\mu'$

The line chart shown was drawn in the conventional manner on log log paper to solve these three equations—using the reference lines A, B and C.

The group $k(C_p\mu/k)^{1/3}$ is of considerable importance and may be included on the chart as follows. Consider group B, and converting viscosity to engineering units:

$$k(C_p\mu/k)^{1/3} = 2.86 \left(\frac{C_p\mu' \times 2.42}{2.86 C_p\mu'} \right)^{1/3} \times C_p\mu' = 2.705 C_p\mu'$$

Therefore for the three groupings, there are the following correlations:

²McAdams, W. H. "Heat Transmission," McGraw-Hill Book Co., New York (1942).

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$$\begin{aligned} A', & \quad k(C_p\mu/k)^{1/3} = 3.066 C_p\mu' \\ B', & \quad k(C_p\mu/k)^{1/3} = 2.705 C_p\mu' \\ C', & \quad k(C_p\mu/k)^{1/3} = 2.513 C_p\mu' \end{aligned}$$

These fit the same line chart with the reference lines A', B', C'.

USING THE CHART

The dotted lines MPRT and MPQS illustrate the use of the chart for ethylene at 122 deg. F. At this temperature $C_p = 0.405$ and $\mu' = 0.0109$ centipoise. The predicted values of k is 0.0128 from the sequence MPRT, compared with a reported value of 0.0131. Following the line MPQS, a value of $k(C_p\mu/k)^{1/3} = 0.0120$ is obtained. This compares with a calculated value of 0.0122.

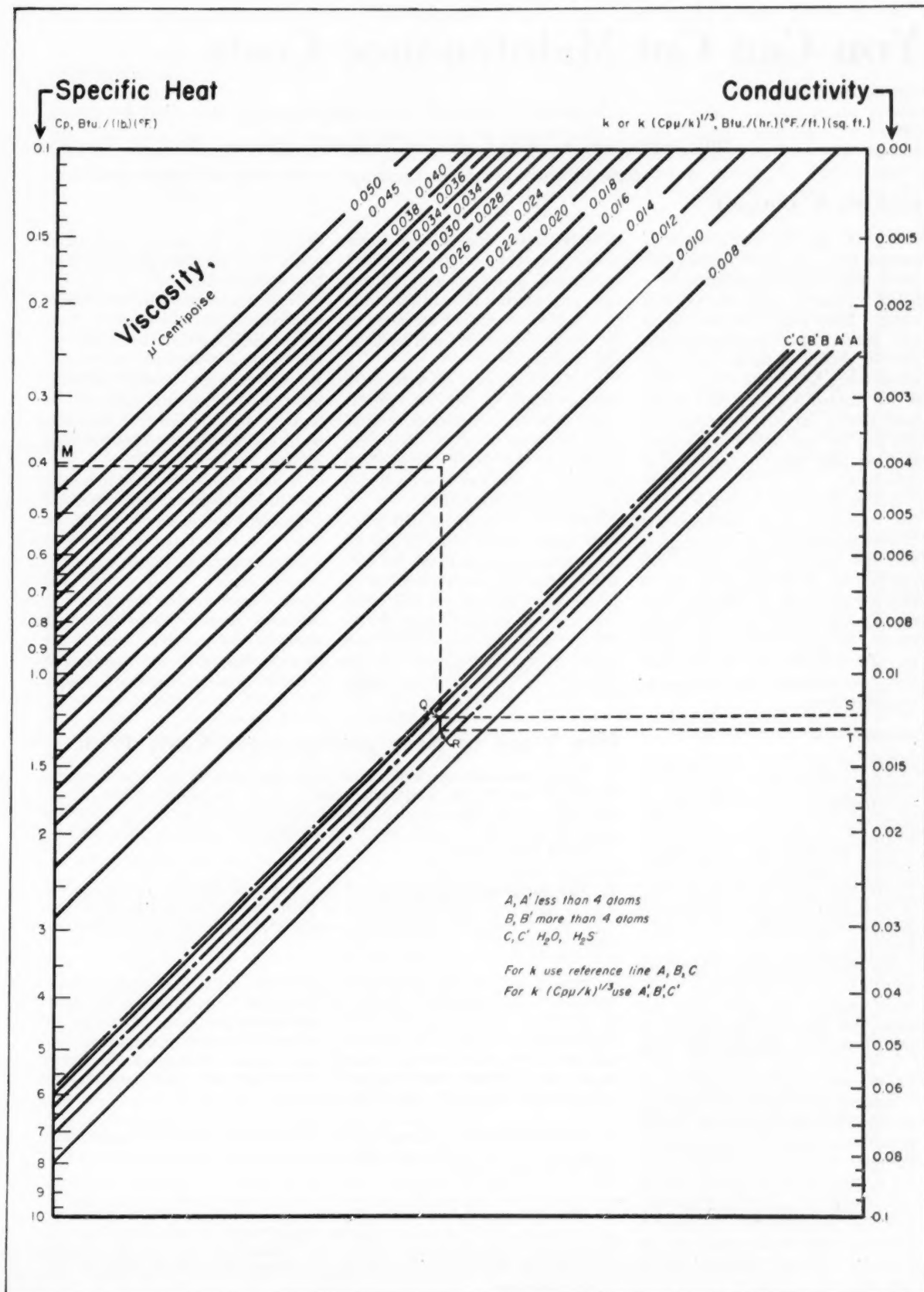
The proposed chart simplifies calculation of heat transfer coefficients and provides a very rapid estimation of thermal conductivity. The latter is believed to be accurate to about 10 percent, although it will depend on the accuracy of the specific heat and viscosity data. The method has been tested only for very moderate pressures and for temperatures in the range 0-600 deg. F.

NOMENCLATURE

C_p	specific heat at constant pressure, Btu./(lb.) (deg. F.)
k	thermal conductivity, Btu./(hr.) (sq.ft.) (deg. F./ft.)
K	ratio of specific heat at constant pressure to specific heat at constant volume.
μ	viscosity absolute, (lb.)/(hr.) (ft.)
μ'	viscosity, centipoises

Note: For convenience, here are some reported values of thermal conductivity of gases:

Substance	Deg. F	k
Air.....	32	0.0140
	212	0.0183
	392	0.0226
Ethylene.....	32	0.0101
	122	0.0131
	212	0.0161
Methane.....	-58	0.0145
	32	0.0175
	122	0.0215
Oxygen.....	32	0.0142
	122	0.0164
	212	0.0185
Propane.....	32	0.0087
	212	0.0151
Sulfur Dioxide.....	32	0.0050
	212	0.0069
Water vapor.....	115	0.0120
	212	0.0137
	392	0.0187
	572	0.0248
	752	0.0315
	932	0.0441



You Can Cut Maintenance Costs

As much as half of a company's net profits may be going into maintenance. Why? Author Leonard answers. And he topples some of the obstacles standing in the way of better practice.

JACKSON D. LEONARD

One of the top executives of a medium-sized chemical company recently made what I consider to be a rather remarkable statement, yet one which I know from experience to be true. He said, "My company has spent over 50 percent of its net profits on maintenance for the past 8 years. This is too darned high for the results we're getting, yet every attempt to cut this cost has met with obstacle after obstacle, and failure to achieve any reduction."

A long discussion with this executive revealed that the obstacles and failures experienced by his company were not unusual. Many others had run into the same wall attempting to improve maintenance practices. It is the purpose of this article to discuss some of the most common obstacles in the path to better maintenance practices, and tell what can be done to overcome them.

ACCOUNTING IS ANTEDILUVIAN

One of the major obstacles most commonly encountered is the lack of good accounting systems. This is especially true in the chemical industries where the accountants have rarely attempted to understand chemical process operations, or even learn the name of the chemical raw materials and products involved in their field of operation.

The result: accounting systems have been set up on a "product basis" where perhaps only direct labor and direct raw materials are charged to each individual product. All other

costs (including maintenance, supervision, laboratory, utilities, supplies) are charged into a common "direct-cost" pool which is then distributed to each individual product according to the amount of direct labor used on that product.

Another commonly used device is the accounting "by areas" or "plants" where all direct costs may be accumulated by areas or plants, and then charged to the product or products produced in that area in a lump sum representing all direct costs.

From the accounting standpoint, these systems result in a unit cost for the products being produced, and serve all the accounting requirements of determining an over-all cost and profit, yet these "pool type" figures can be highly misleading. Many times such figures conceal the true cost of producing some products to the extent

that some are produced at a loss while others are much more profitable than they appear to be.

From the maintenance standpoint, such systems give absolutely no basis for comparison or control of costs. Systems such as these have no place in the well-managed, modern industrial plant, unless they are supported by separate and detailed cost accounts which will show the direct cost of each element involved.

It is also highly important that costs on individual pieces of equipment, and individual repair jobs be available, for it is these costs that can be used to achieve control and reduction of maintenance expense. It is virtually impossible to effect any kind of a cost reduction program unless such cost information is available. With all the modern simplified and mechanized methods of accounting that are avail-

Five Ways to Keep Maintenance Costs High

1. Faulty Accounting: Make sure your accountants don't understand chemical operations; keep accounting on a "product" basis charging only direct labor and raw materials to each product, all other costs to a common pool which is divided according to the amount of direct labor used.

2. Tax Juggling: Charge capital improvement costs to maintenance. You'll save tax dollars but get a distorted maintenance cost picture that'll make it practically impossible to judge performance or control costs.

3. Closed Minds: Remain at loggerheads with your independent-thinking maintenance supervisors by either "laying down the law" to them or accepting defeat by admitting that the "know-it-all" maintenance men won't go along with a cost-cutting program. You can also find closed minds among "self made" managers who sometimes won't admit that a complex maintenance problem exists and refuse to believe that it can be corrected.

4. Trial and Error: Let your junior accountants flounder around with complex and disorderly cost reduction programs. You may spend four dollars to save three.

5. The Piecemeal Approach: If somebody comes up with a good over-all program for the maintenance department to straighten out deficiencies in organization, tools, etc., never put the entire program into effect. Instead, try one small portion at a time. Results are sure to be poor.

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"A good maintenance survey will almost always pay for itself many times over."

able, it is surprising how few companies have realized the importance of such information.

Several years ago while preparing an article outlining the costs of maintaining various types of process equipment (See *Chem. Eng.*, Sept. 1951), over 100 chemical companies and equipment manufacturers were asked if they had information available on the cost of maintaining individual pieces of equipment. Only six had such information available and they regarded it as so important that they classified it "confidential." They admitted that the information had been very revealing to them in several ways but chiefly, it had proven to them that certain equipment was much more costly to maintain than anyone had suspected. They also admitted that the information had permitted cost reduction measures that had paid the price of accumulating the information many times over.

THE TAX SITUATION COMPLICATES

Perhaps one of the hardest obstacles to overcome today is the fact that the present high taxes have led many companies to charge off as much of their capital improvements as possible to maintenance costs. By so doing, their gross profits are greatly reduced, and consequently, their tax liabilities are also reduced. Since corporate income taxes now take at least 72 cents out of every income dollar, it can readily be seen that capital improvements charged into maintenance expense will actually cost the company only 28 cents for every dollar spent.

The accounting divisions of many companies have gone to great lengths to set up devices to take advantage of this situation, and have sometimes battled for years with the Federal income tax collectors to obtain special rulings on the accounting devices that permit taking advantage of this situation as much as possible. The arguments advanced for these devices are complex, and it is not the intent of this article either to defend or condemn them.

However, while such practices may be to the company's advantage so far as taxes are concerned, they serve to distort maintenance costs and make it almost impossible to judge performance or control costs, unless simple

accounting methods are used within the maintenance department itself to obtain job costs, equipment costs, and other direct costs. This is the solution that must often be used in cases of this kind. Figures compiled by the maintenance cost clerk are not recognized for accounting purposes, but do serve as control points, and performance bases within the maintenance department.

CLOSED MINDS DON'T HELP

Another common obstacle in the path to better maintenance is the attitude of maintenance supervision itself. The "prima-donna," the "know-all-the-answers," and the "strong-silent" types are quite prevalent. A well-known industrial psychologist has analyzed this problem, and attributes these attitudes to the fact that maintenance supervisors must develop a high degree of independent thinking and action. Obviously their attitudes are bound to reflect this.

In other words, when a machine won't run or operate properly, the maintenance "doctor" is called upon to determine what is wrong, and how best to correct it. This demands independent thinking and action plus initiative and results in an over-developed sense of the individual's importance. The prima donna, know-it-all, and strong-silent-won't-discuss-anything types are the result.

To a lesser degree, individual maintenance mechanics and craftsmen are required to have some of the same traits, and it's well-known that these men are much more difficult to supervise and direct than other workmen. This added burden also tends to make maintenance supervisors resist changes or innovations that might increase their supervisory problems.

Recognition of these basic facts permits experts not only to overcome this attitude, but also take advantage of these admirable characteristics. For instance, when a survey of the maintenance department indicates that they are lacking in some respects, the best approach involves sitting down with all of the supervisors in that department and presenting to them the facts concerning their present methods of operation, and the suggested methods for correction. After outlining the situation along broad lines, the next step

is to seek their cooperation in filling in the details.

This type of approach will produce some rather amazing results because the analytical thinking of the group will invariably come up with excellent ways to achieve the desired results. Encouraging these ideas from the group itself, tends to promote good cooperation in getting the new measures into effect.

An outside consultant who is experienced in this field, can survey a company's maintenance department, determine its needs and deficiencies, point these out to maintenance supervision in the course of developing the survey information, and then submit a recommendation report giving a broad outline of the recommended corrections which maintenance supervision will be fully aware of, and prepared to cope with, by the time the report is issued.

Such an approach will eliminate much friction, and achieve the maximum result. A planned maintenance program employs just this approach and allows plenty of room for initiative, and independent thinking and action within its framework.

MANAGEMENT ATTITUDES

One of the toughest obstacles encountered is the attitude sometimes found within the ranks of top management. Of these, perhaps the worst to deal with is the small company that just grew and grew, until today the plant represents a multimillion dollar investment, usually built without benefit of any orderly development pattern. The crazy-quilt accumulation of facilities is maintained by a motley assortment of mechanics and craftsmen working from scattered small shops, or no shops at all, on a "break-down" basis.

Strangely enough, managing these companies are top notch production men who have worked long and hard to build the company up from its humble beginnings to its present state. They cannot comprehend the scope or complexity of the maintenance problem, nor why it should be costing so much to maintain their plant. It is also quite difficult to convince these "self-made managers" that maintenance cost would be cheaper, and produce far better results if top quality

"But don't take on a cost-reduction plan unless you know what you're doing."

supervision and adequate shops and tools were provided. This type of company usually prospers in boom periods, but cannot survive the tough competitive struggles of the lean years.

THE ROLE OF THE CONSULTANT

The consultant who is expert in this field can determine quickly and impartially, the real needs of the maintenance department, get their support for a new program while investigating their needs, and then present his recommendations in such a manner that all factions in the company can clearly see the need for and benefit in the recommended program. Friction and internal politics can be completely avoided by such an approach, and it offers, by far, the safest, cheapest, and fastest method open to management to achieve good results.

This approach to the problem avoids "trial and error" methods which are quite costly and time consuming. It has been estimated that a good consultant in the field can establish a sound program for 10 percent of the cost and about 15 percent of the time that it would take company personnel to do the same job by means of trial-and-error methods. In addition, the methods and procedures set up by the consultant would be far more efficient and productive than those developed with company personnel.

For example, not long ago the plant engineer of a large chemical company complained that he felt that the cost of obtaining maintenance costs on individual pieces of equipment was so high, that even though it had provided information which permitted some good cost reductions, he wondered if it would pay for itself over a period of time. When I reviewed his system, I was amazed to find that it involved an elaborate set of files, forms, cards, and two full-time clerks. When I showed him how the necessary data could be obtained from one simple file and the part-time services of a single clerk, he readily agreed that a little expert help was quite worthwhile.

Another company was approached several years ago by a reliable consultant who offered to establish a good work order system which would yield job costs and equipment costs for a modest fee of several thousand dollars. The use of his work methods,

would require the services of one full-time clerk to obtain the necessary data.

Management of the company decided that one of its junior accountants was better equipped to set up the needed system, so they rejected the proposal and proceeded on their own. Two years later, the company system had developed into a battery of IBM machines with three operators, and a full-time clerk to report the desired data. Rental on the IBM machines alone ran into several thousand dollars per month. While the system could yield all kinds of data, only a few key facts and figures were of any real value in controlling or reducing maintenance costs.

FOLLY IN THE PIECEMEAL APPROACH

All too often, a piecemeal approach is attempted on the maintenance problem. For example, some member of the company organization will seek approval for an over-all program in the maintenance department which would straighten out deficiencies in organization, tools, facilities, technical assistance and accounting practices. He might finally gain permission to try a small portion of the program. The decision in these cases is usually based on the false reasoning that it is better to take on new procedures one at a time and see what results are obtained before proceeding with other new methods.

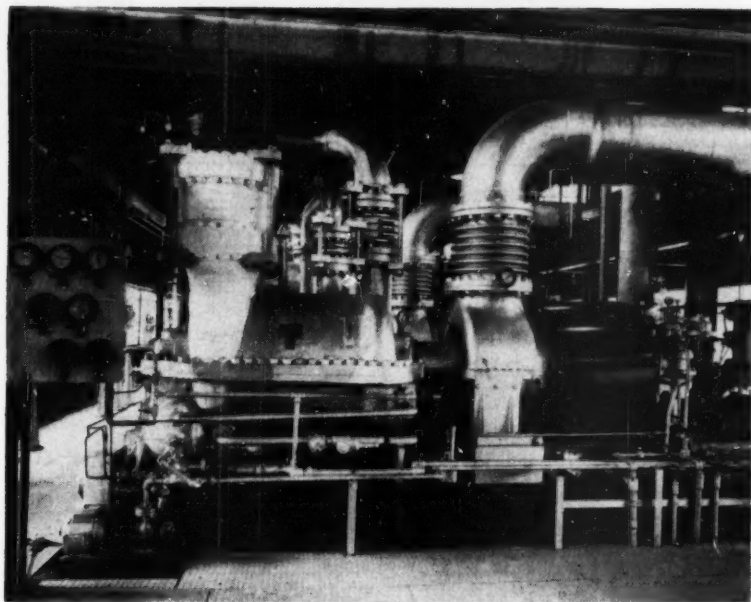
The results in such cases are almost always highly disappointing. It can be likened to the hypothetical case of a baseball manager who would attempt to send a team composed of a pitcher and catcher to play against the league-leading Yankees on the basis that if the pitcher and catcher made out OK, it would then be safe to proceed to add other players one at a time. Silly as this may seem, it is no more foolish than the organization which elects to improve its maintenance performance "piecemeal." To get a really good maintenance performance requires a well balanced organization that has all the necessary training, adequate tools and facilities, good accounting practices, a good work order system, and sound methods and procedures. Lack of any one of these components will lower the effectiveness of all the others. In other words, a full team is needed to do a good job.

The rewards in the chemical industry for a successful program can be measured in thousands of dollars of savings and in terms of plants that operate better with fewer breakdowns, and usually with improved quality of product.

This explains why those companies that have established successful maintenance programs are not advertising this fact. Certainly, it must seem very strange to some executives that their competitors are able to reduce the selling price on their products, and continue to earn profits, while their own operations are scarcely able to break even.

A good modern example of this is the manufacture of penicillin. Certain companies in this field have reduced the selling price over a period of years to the point where many of their competitors are unable to earn any profit, and some cannot even break even. Yet, practically all of the major penicillin plants utilize essentially the same process, have much the same equipment, and should have the same costs, but don't. Fortunately, most products are not as highly competitive as the example used, so that both the efficient, and the inefficient producer, and managers are able to survive under normal circumstances.

Just as intelligent, streamlined economic analysis and evaluation has helped to eliminate research and development efforts that would never "pay off," a planned maintenance program can be used to eliminate waste, excessive costs, and keep the physical assets of the company in tip-top condition. In other words, planned maintenance is just as essential to any company's health as intelligent research, sales, or operations. The competitive market looming ahead of us in the next few years will be an opportune time for executives to put their houses in good order with better, and more economical maintenance practices. Even though the obstacles may seem difficult to overcome, the results can be well worth the effort, and when expert help is available to overcome the obstacles, and direct the establishment of effective, result-getting programs, then good maintenance can be within easy grasp of any company interested enough to decide that better maintenance is their desire.



Multistage Centrifugal Compressors . . .

How Speed Affects Performance

Here are some new centrifugal compressor performance data for propane. Chemical engineers are becoming increasingly interested in these machines and how they work.

T. E. CORRIGAN and A. F. JOHNSON

As you vary the speed of a multistage centrifugal compressor to take care of changing conditions of suction or discharge, the change in the volume of gas entering the upper stage wheels has a major effect in determining the capacity of the compressor. We can almost say that the compressor has more capacity at high discharge pressures than it does at low discharge pressures, assuming that we hold the suction pressure constant. The increase in the volume of gas entering the latter stages is due to the increase in specific volume of the gas as its pressure is lowered.

An installed compressor has a fixed internal volume for the gas to fill up. This is a variable which we can not change.

To determine the operation at reduced speed, we can use the fan laws. Assuming no change in temperature, or density, of the inlet gas, capacity is proportional to speed. Pressure is

proportional to the square of speed. And horsepower is proportional to the cube of speed. For a single wheel machine the fan laws have been found to hold rather well in many cases.

But in a multistage machine the increase in specific volume, as mentioned above, tends to overload the higher stage wheels. As a result of this the whole compressor has to be operated faster than might be expected. Actually this is a very favorable effect because it means that less speed reduction is required over a wide range of discharge pressures. It also means that on constant speed machines, less throttling is required for widely varying conditions that may be set for the head pressure.

Another statement that is often made about multistage centrifugal compressors is that they "work from the top down." The head pressure is determined by the system characteristics. For example, by condenser pres-

sure—which in turn is a function of condenser water flow and temperature, condenser size, etc. With the head pressure set by an external source, the compressor will pull down to a certain suction pressure at the inlet. This is determined principally by its speed.

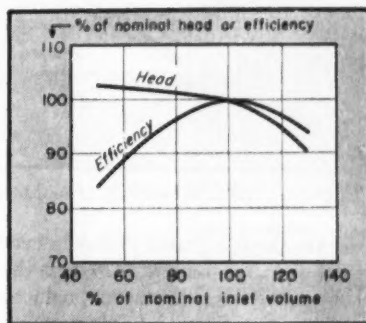
The volume of gas being handled has some bearing on the suction pressure that will be reached. But the principal governing factor is the speed of the compressor itself. The curves bring this out. We show the operation of multistage centrifugal compressors on propane for suction pressures of 0, 25, and 50 psig., and all operating at head pressures varying from 100 psig. to over 200 psig. in some cases.

You can see that the compressor that has the highest compression ratio requires less speed variation than the compressor with the lowest compression ratio. For example, the compressor operating at 0 psig. suction pressure would run at about 84 percent of design speed to deliver a head pressure of 90 psig. The compressor operating at 50 psig. suction pressure has to drop down to 75 percent of design speed when the head pressure must not exceed 90 psig.

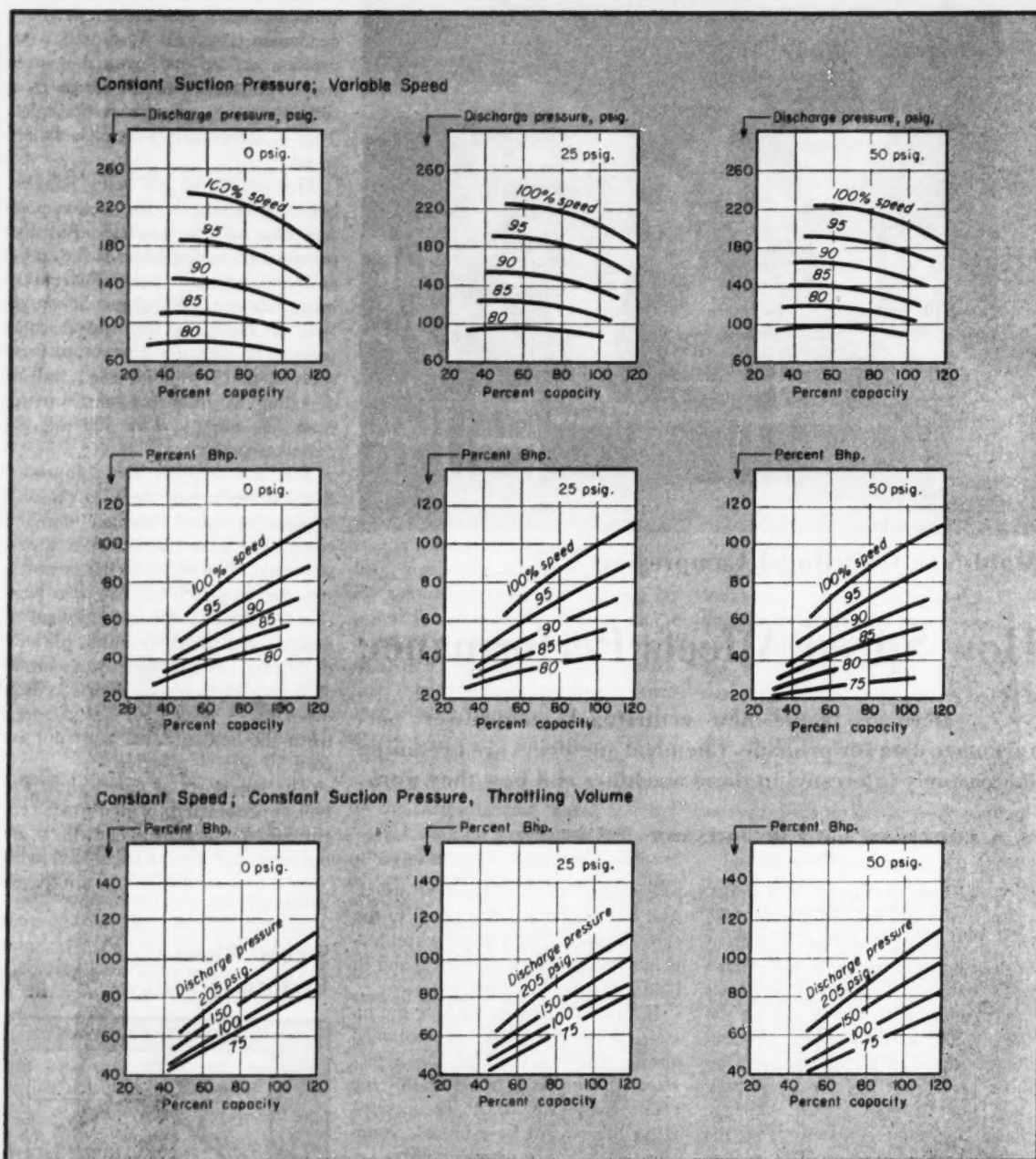
The lowest set of curves show the typical performance of multistage centrifugal compressors when they are operated at constant speed and with

(Turn page)

Single Wheel Performance . . .



The typical performance of a single wheel is indicated above. Note particularly that it is characteristic of a centrifugal wheel to have a rather flat head curve. At a given speed the head characteristic of a multistage compressor is practically the same as that of the individual compressor wheels.



TYPICAL PERFORMANCE of multistage centrifugal compressors on propane. You vary the speed or throttle the suction.

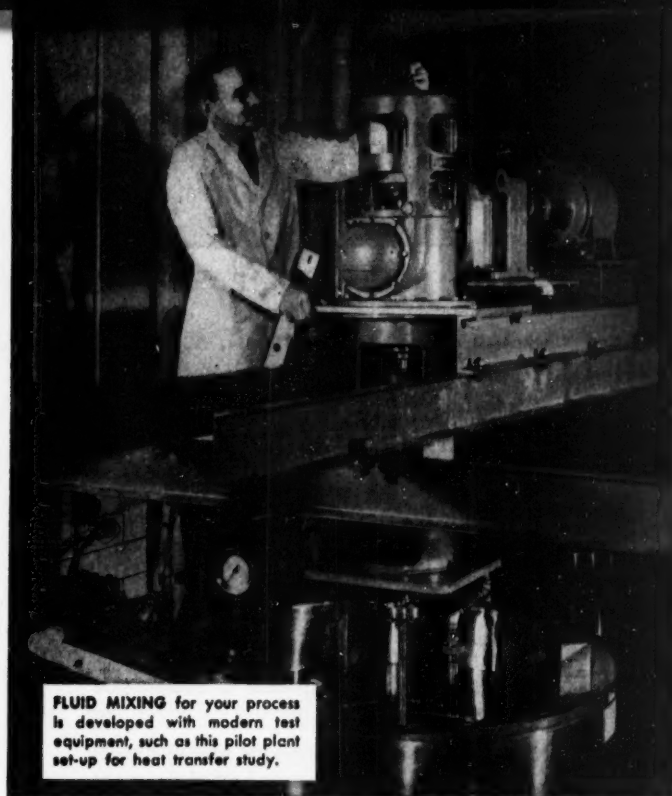
suction throttling used to hold a constant discharge pressure. Although the horsepower does decrease at reduced loads and at reduced head pressures, the reduction in horsepower is not as great as with a variable speed drive. Nevertheless, precise control is possible if you use the proper control instruments. The compressor can be operated automatically at any point under the 100 percent speed curve as

called for by the system of which it is a part. This is true whether speed control is used or whether you use suction throttling with a constant speed drive.

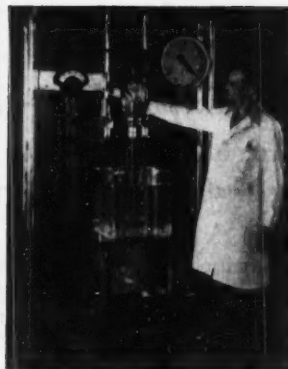
The multistage compressor is well suited to a wide load variation either with or without a wide variation in head pressures. Control of the centrifugal machine to maintain constant suction pressures can be obtained with speed control. But if a constant speed

drive is used then suction damper control must be installed.

TOM CORRIGAN and AL JOHNSON are the popular authors of your CE REFRESHER. For a better understanding of the principles of centrifugal compression, you are invited to turn the page.



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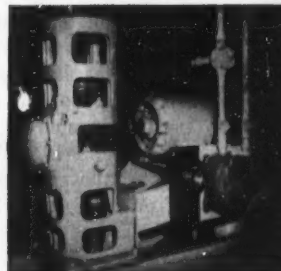
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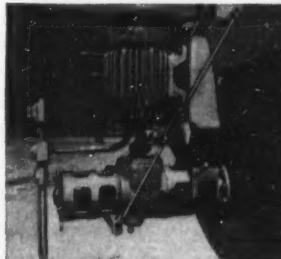
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Chemical Engineering Fundamentals



Compression and Expansion—III

THOMAS E. CORRIGAN, Research Engineer, Mathieson Chemical Corp., Niagara Falls, N. Y.

A. F. JOHNSON, Sales Engineer, Carrier Corp., Cleveland, Ohio

We used the classical approach in the two previous sections on compression (See Chem. Eng., Dec. 1953, p. 211 and Jan. 1954, p. 210) which evolved from the concept of a frictionless piston with zero clearance. This wasn't so bad for reciprocating compressors. But the operating characteristics of centrifugal compressors are different. We'll have to talk about them somewhat so that applications involving centrifugal machines can be evaluated.

A centrifugal compressor converts the kinetic energy of a gas into pressure just as a centrifugal pump does when it handles water or any other non-compressible fluid. Look at Fig. 1. Here we have a multi-stage centrifugal compressor. Fig. 2 is a cut-away view. Let's follow the path of gas going through (Fig. 3). The gas enters the wheel at point 1 and leaves at point 2, where most of the energy is kinetic. This is converted to static energy in flowing from 2 to 3 (visualize a path with an enlarging circumference).

During the flow from 3 to 4 there is little change in pressure because the widening path is also one of decreasing circumference. There is little change in velocity. At point 4 the gas is again given a high velocity shove that is converted into static pressure as it slows down from 5 to 6.

On a p - H diagram (Fig. 4), the path from point 1 to point 4 is a straight line for all practical purposes. The energy conversions which occur are of prime interest to mechanical engineers but of little use to the user of the equipment. And with this brief background in centrifugal machinery we'll go on to some theory.

Thermodynamics for Centrifugal Compression

The principles of thermodynamics which apply to centrifugal compression start with the ideal gas equation, $pV = RT$. The units will be as follows:

p = absolute pressure, lb./sq. ft.

V = specific volume, cu. ft./lb.

R = the gas constant (see Table I for units)

T = absolute temperature, deg. R.

Remember that only non-condensable gases or superheated vapors behave like ideal gases. Vapors near saturation are non-ideal. We must use thermodynamic diagrams (if available) to determine the properties of saturated vapors or for vapors with low superheat values.

Other useful gas equations are:

$$p_2/p_1 = (V_1/V_2)^n \text{ and } T_2/T_1 = (V_1/V_2)^{n-1}$$

where T_1 = suction temperature and T_2 = discharge temperature. Both are in deg. R.

Combining these equations,

$$T_2/T_1 = (p_2/p_1)^{(n-1)/n}$$

For any pressure ratio, p_2/p_1 , the value doesn't depend on the units of absolute pressure which are used (never, however, psig.). The temperature, T , is always in deg. R.

The value of n is another problem. It comes from the equation,

$$n/(n-1) = k/(k-1) \times \text{Efficiency}$$

in which k equals the adiabatic exponent of compression in the equation $pV^k = \text{a constant}$.

Also $k = C_p/C_v$, where C_p is the specific heat of the gas at constant pressure and C_v is the specific heat of the gas at constant volume. Various tables give values of C_p , C_v , and k for common gases. Remember that these values are for specific pressures and temperatures. If your problem is not in the same range, expect deviations.

The term n is an empirical constant used as a substitute for the adiabatic constant k . The variation between n and k accounts for two things: that the process is not frictionless (less than 100 percent efficiency) and that the process is not isentropic but is polytropic. The term k comes from the relationship between T and p in the isentropic process and is derived as follows:

$$\Delta S = C_p \ln (T_2/T_1) - R \ln (p_2/p_1) = 0$$

$$C_p \ln (T_2/T_1) = R \ln (p_2/p_1)$$

$$\ln (T_2/T_1) = (R/C_p) \ln (p_2/p_1)$$

or,

$$T_2/T_1 = (p_2/p_1)^{R/C_p}$$

Also, for an ideal gas,

$$C_p - C_v = R$$

NOMENCLATURE (Consistent Units)

a, b, c, C	Constants
C_p	Heat capacity at constant pressure
C_v	Heat capacity at constant volume
MC_p	Molal heat capacity at constant pressure
H	Enthalpy
k	Adiabatic compression exponent ($pV^k = C$)
M	Molecular weight
n	Polytropic compression exponent ($pV^n = C$)
p	Pressure
p_c	Critical pressure
p_r	Reduced pressure
R	Universal gas constant
S	Entropy
T	Absolute temperature, deg. K or deg. R.
T_c	Critical temperature
T_r	Reduced temperature
V	Volume
W	Work or head
y	Mole fraction
z	Compressibility factor
β	A function of n and p (see page 220)
Δ	Finite change in a property

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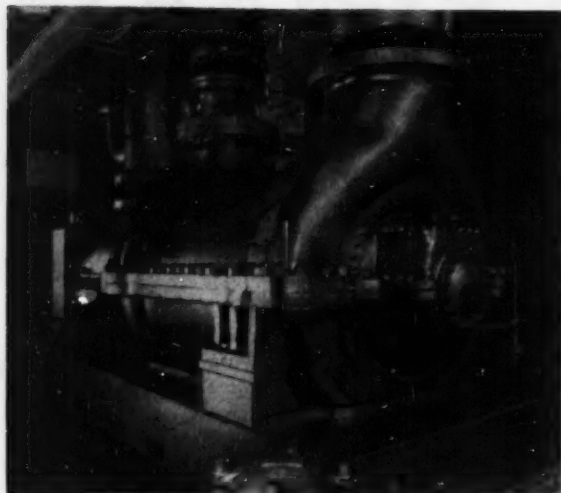


Fig. 1—Multistage centrifugal compressor, outside view.

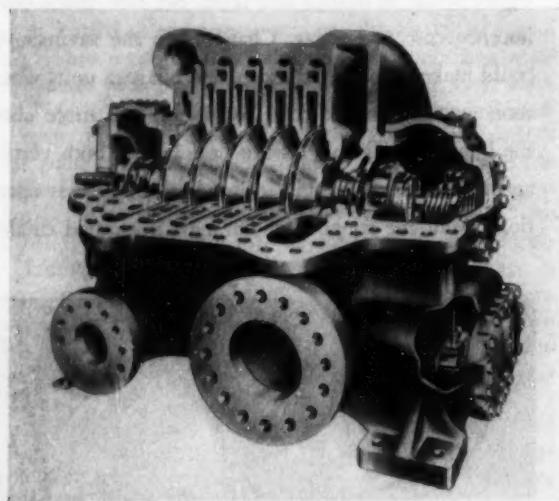


Fig. 2—A cut-away view of the same compressor.

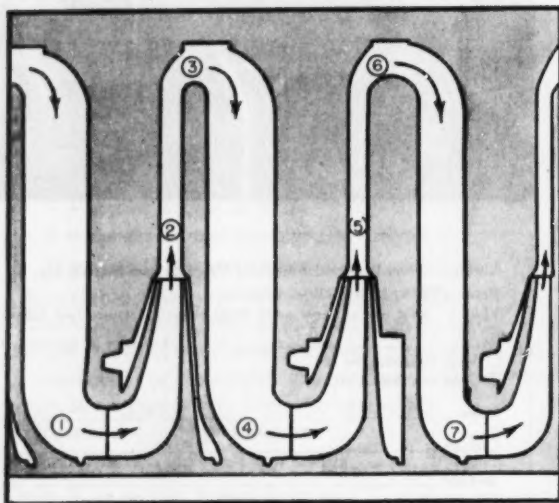


Fig. 3—Gas flows along this path through the compressor.

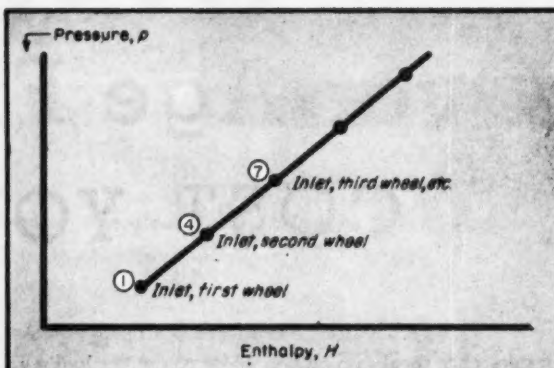


Fig. 4—The path shown on a pressure-enthalpy diagram.

and

$$R/C_p = (C_p - C_v)/C_p = 1 - (C_v/C_p)$$

If we define the ratio C_p/C_v as k , then

$$R/C_p = 1 - (1/k) = (k - 1)/k$$

and

$$T_2/T_1 = (p_2/p_1)^{(k-1)/k}$$

The corresponding relation between temperature and volume is,

$$\begin{aligned} \Delta S &= C_v \ln(T_2/T_1) + R \ln(V_2/V_1) = 0 \\ \ln(T_2/T_1) &= -R/C_v \ln(V_2/V_1) \\ T_2/T_1 &= (V_1/V_2)^{(R/C_v)} \end{aligned}$$

but

$$R/C_v = (C_p - C_v)/C_v = k - 1$$

and

$$T_2/T_1 = (V_1/V_2)^{k-1}$$

For the actual process (which is polytropic and not 100 percent efficient) n is substituted for k . Since n is an empirical constant, it can't be calculated from a knowledge of the properties of the system alone. Thus, n is also a property which depends on the path used.

Even for a reversible adiabatic process the equations containing k are not strictly rigorous since k varies with temperature. The exact expression for k is

$$k = \frac{C_p}{C_v} = \frac{a + bT + cT^2}{a - R + bT + cT^2}$$

The rigorous expression for the relation between T and p in an adiabatic process is

$$T_2/T_1 = (p_2/p_1)^x$$

where x is equal to $R/(a + bT + cT^2)$.

But here T on the right-hand side is a variable which varies between T_1 and T_2 during the process. The equation isn't practical for a rigorous calculation.

The Head Concept

Since centrifugal compressors are used to compress gases and vapors which have molecular weights anywhere from 2 to 150, the term "compression ratio" has little meaning. A more useful concept is head.

Compressing a gas from one pressure to a higher one may be thought of as pushing the gas from one level to another. The distance that 1 lb. of the gas is pushed is the head, measured in ft., of the gas we are considering. A compressor running at a given speed and volume load-

BUSINESS IN MOTION

To our Colleagues in American Business...

Revere, like other companies, prefers to avoid rush orders, because they tend to upset orderly scheduling of production and shipment. However, we are not bound by system, and will do everything we can to help when a customer faces a genuine emergency. Sometimes, of course, in spite of the best will in the world, we encounter conditions beyond our control. A metal shortage is one example. But when there is an overwhelming need for speed sometimes we can meet it.

Let us cite a recent case. An important customer on the West Coast had spoiled two circular tube sheets while drilling them. This message was relayed by telephone to our New Bedford mill where we produce these sheets. How soon could we replace them? They were for an important government project. So urgent was the need that the customer offered to charter a plane to fly them to California as soon as they were ready.

A quick check showed that we could make duplicate sheets much more quickly than usual. The specified alloy was in stock, partially processed, so that casting time was eliminated, as well as some of the rolling. It was rolled down to the required gauge, 1 1/8 inch thick, leveled, and cut into two circles, each 98 inches in diameter.

Meanwhile, the Traffic Department worked on the rather complicated problem of determining the fastest, most direct, yet least expensive way to get the circles to the Coast. Because of the weight and the

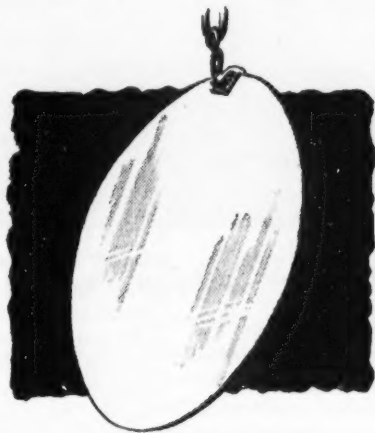
time already saved, shipping by plane entailed a cost that didn't seem justified. Traffic reported that the best solution was to ship by "direct car," which guaranteed no extra handling or trans-shipping en route. This was agreed to by the customer, and four days after he called us, the circles were thus shipped. They arrived eleven days later, in time to meet the deadline.

Was the extra effort required to rush through 5,000 pounds of tube sheets justified? We are sure it was.

Two days after the circles arrived we received a letter from the customer, in which he said: "The promptness with which your company undertook the problem of supplying the two sheets to replace those we had spoiled has been appreciated by all of us. . . . It is most heartening to work with persons who have a real sense of responsibility and concern over their customers' emergency requirements. Your company's performance in this instance left

nothing to be desired and we want you to know that it meant a great deal to all of us."

As we have remarked, we do not relish rushes any more than anybody else, but when there is a situation of real gravity, we will do our best to cope with it. Other suppliers in all industries, we have observed, follow much the same policy, so we suggest that when a genuine emergency arises, tell your suppliers the exact nature of it and ask them what they can do for you. They may be able to find a way to help you, as Revere did in the case just cited.



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ing will theoretically produce the same head regardless of the fluid being pumped.

Imagine two adiabatic columns[†] of gas, each 30,000 ft. high with the same temperature and pressure at their uppermost ends. Suppose one column is methane vapor ($M = 16$), and the other is butane vapor ($M = 58$). The unit pressure at the base of the butane column will be much greater than at the base of the methane column. Because the molecular weight of butane is higher.

Actually the unit pressure at the base of the methane column would be about 8 psig., and at the base of the butane column about 85 psig. This assumes 1 atm. at the tops of the columns. Turning our thinking around a bit, for a given compression ratio (ratio of absolute discharge pressure to absolute suction pressure) the head required is lower for the gas having the higher molecular weight.

Calculating Head

Head is an energy term. It is expressed as energy per unit mass. Its dimensions are force \times distance/mass; and its units are lb. (force) \times ft./lb. (mass). Although this isn't strictly cricket, it is an abbreviation that is commonly accepted throughout the industry. Head in ft. is understood to mean potential energy in ft.-lb. per lb. of material.

Head is calculated from the equation:

$$\text{Head} = 144 p_1 V_1 / (n - 1) [(p_2/p_1)^{(n-1)/n} - 1]$$

where p_1 = suction pressure, psia.; p_2 = discharge pressure, psia.; V_1 = specific volume at the suction, cu. ft./lb.; and n = the exponent of polytropic compression in the expression pV^n = equal to a constant.

Substituting with the ideal gas equation gives us:

$$\text{Head} = RT_1 [n / (n - 1)] [(p_2/p_1)^{(n-1)/n} - 1]$$

where $R = (1,544/M)$ ft.-lb./lb.-deg. R . See Table I for other values of R .

Then for a given gas, raising the inlet temperature, T_1 , increases the head required to obtain the compression ratio needed. This means that intercooling decreases the head, and so the horsepower, on succeeding compression stages. We have omitted the effect of compressibility to simplify this approach. We'll discuss it later.

Approximate Head

The head equations, above, can be combined and graphed. Fig. 5 shows how to get the approximate head for any set of conditions. The small curves in the corner show the relationship between k , n , and efficiency. Fig. 5 is also very useful for showing the variation in head as operating conditions are changed. For example, if compression ratio, polytropic constant, and suction temperature are fixed, we can see that the lower molecular weight gases require more head for a given compression ratio.

It is to be expected that if a centrifugal compressor is picked for a certain molecular weight gas, a reduction in the molecular weight of the gas being handled will give a lower compression ratio. This is in spite of the fact that the delivered head will be the same, regardless of the material. (Of course, this means at constant speed also.)

[†]An adiabatic column of gas is a hypothetical column of an ideal gas of infinite height insulated from its surroundings and under a constant gravitational effect. As a plug of gas is assumed to travel up and down the column, its temperature will vary with its volume and pressure in accord with the conservation of energy law.

Table I—Values of the Gas Constant, R

Units of Pressure	Units of Volume	Units of Temperature	Units of R	Numerical Value of R
atm.	cu. ft. lb. mole	$^{\circ}R$.	atm.-cu. ft. lb. mole- $^{\circ}R$.	0.729
lb./sq. in.	cu. ft. lb. mole	$^{\circ}R$.	lb./sq. in.-cu. ft. lb. mole- $^{\circ}R$.	10.73
lb./sq. ft.	cu. ft. lb. mole	$^{\circ}R$.	Btu. lb. mole- $^{\circ}R$.	1.987
atm.	cu. ft. lb.	$^{\circ}R$.	atm.-cu. ft. lb.- $^{\circ}R$.	0.729 M
lb./sq. in.	cu. ft. lb.	$^{\circ}R$.	lb./sq. in.-cu. ft. lb.- $^{\circ}R$.	10.73 M
lb./sq. ft.	cu. ft. lb.	$^{\circ}R$.	Btu. lb.- $^{\circ}R$.	1.987 M
lb./sq. ft.	cu. ft. lb.	$^{\circ}R$.	ft.-lb. lb.- $^{\circ}R$ or $^{\circ}R$.	1544 M

M is the molecular weight.

Calculating Head for Non-Ideal Gases

Calculations involving the compression of a saturated vapor or a vapor near the saturation line should be made using enthalpy-temperature, pressure-enthalpy, entropy-temperature diagrams or Mollier charts, if they are available. The charts will give us specific volumes. Then we can calculate the approximate head this way,

$$\begin{aligned} \text{Head} &= \frac{1}{2} (p_1 V_1 + p_2 V_2) \ln (p_2/p_1) \\ &= \frac{1}{2} (144) (2.3) (p_1 V_1 + p_2 V_2) \log (p_2/p_1) \\ &= 166 (p_1 V_1 + p_2 V_2) \log (p_2/p_1) \end{aligned}$$

Where p_1 = suction pressure, psia.; p_2 = discharge pressure, psia.; V_1 = specific volume, suction conditions, cu. ft./lb.; and V_2 = specific volume, discharge conditions, cu. ft./lb.

We have used the arithmetic mean (pV) rather than the log mean (pV). This simplified approach works since the error is between 1 and 2 percent. And its on the safe side anyway. The suction temperature and pressure as well as the discharge pressure must be specified. In refrigeration cycles you must be careful to determine actual suction and discharge conditions. They may be affected by superheating or line pressure losses.

In the above equation, the one term that we don't know at the beginning is V_2 . It can be estimated from a pressure-enthalpy diagram. See Fig. 6. Here H_1 is at the suction condition. Follow up a line of constant entropy to the discharge pressure and read the enthalpy, H_2 , at that point. Assume an over-all efficiency.

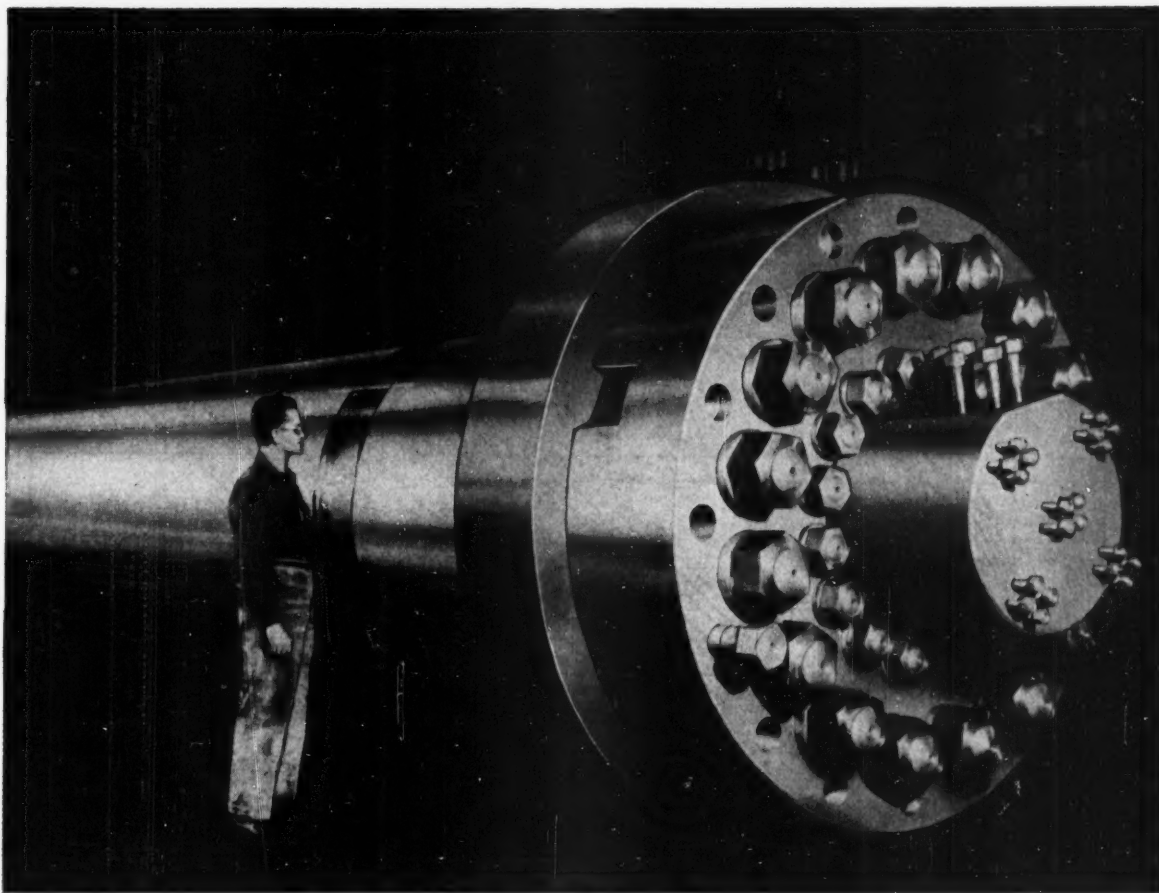
$$\Delta H = (H_2 - H_1)/\text{EFF. and } H_2 = H_1 + \Delta H$$

At the intersection of lines p_2 and H_2 read the specified volume, V_2 .

Centrifugal Compression of Non-Ideal Gases

We shall derive our compression equations for non-ideal gases as if we were dealing with ideal gases. But our equation of state will not be $pV = RT$. Instead we must insert the compressibility factor, z , so that $pV = zRT$. Similarly for mixtures of gases, z must be determined by the pseudo-critical method first and then we can find the p - V - T relationships for the mixture (see *Chem. Eng.*, Nov. 1953, pp. 203-207).

On this basis we can go on to finding the head required by a centrifugal compressor. The head is the work done in raising the gas from one pressure to another. The basic equation is: $W = \int V dp$ between the limits p_2 and p_1 .



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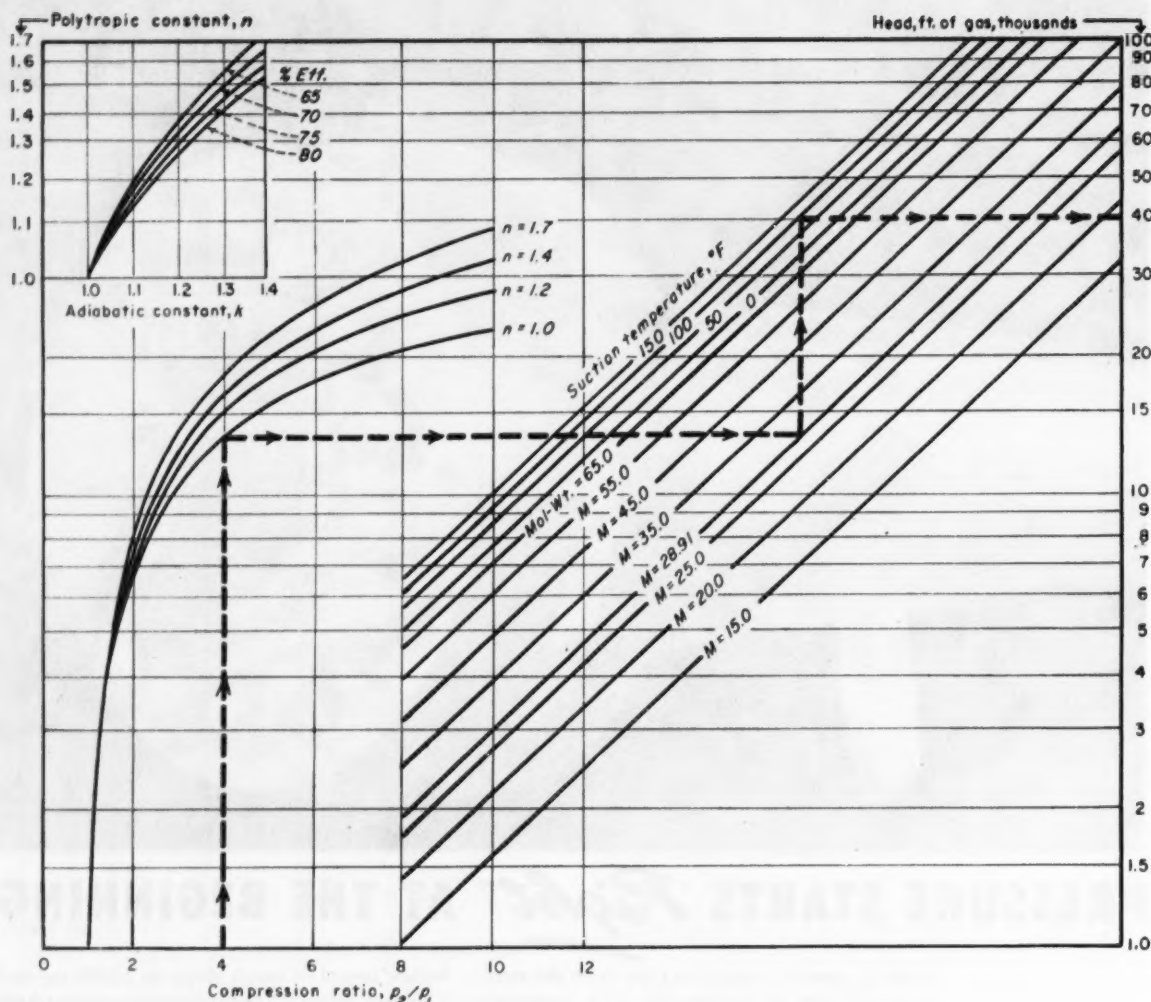


Fig. 5—Approximate head selection chart shows how to get the head for any set of conditions.

In actual cases the compression is polytropic rather than being isothermal or adiabatic. And the equation of the polytropic curve is $pV^n = p_1(V_1)^n = p_2(V_2)^n = C$. For a constant entropy, adiabatic process, the expression would be $pV^k = \text{a constant}$ (where $k = C_p/C_v$). We substitute n for k in the polytropic equation. This leads to an expression that is not strictly rigorous. But it is perfectly satisfactory for engineering calculations.

The adiabatic expression, $pV^k = C$, is developed for an ideal gas as follows:

$$\begin{aligned}\Delta S &= C_p \ln(T_2/T_1) - R \ln(p_2/p_1) = 0 \\ \Delta S &= C_v \ln(T_2/T_1) + R \ln(V_2/V_1) = 0 \\ \ln(T_2/T_1) &= (R/C_p) \ln(p_2/p_1) = - (R/C_v) \ln(V_2/V_1)\end{aligned}$$

Therefore,

$$\begin{aligned}\ln(p_2/p_1) &= - (C_p/C_v) \ln(V_2/V_1) \\ p_2/p_1 &= (V_1/V_2)^{C_p/C_v} \\ p_2/p_1 &= (V_1/V_2)^{C_p/C_v} = (V_1/V_2)^{1/(1-n)}\end{aligned}$$

And finally,

$$p_2(V_2)^n = p_1(V_1)^n$$

Since this relation can be worked out for any final conditions, with the single restriction that ΔS of the process

is zero, the general expression, $p_1(V_1)^n = p_2(V_2)^n = pV^n = C$, must be true.

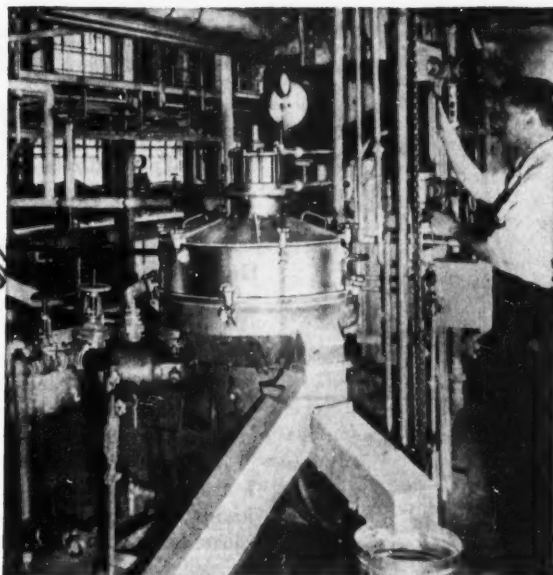
Polytropic Flow Work

Now let's derive an expression for polytropic flow work from $W = \int V dp$ and $pV^n = C$.

$$\begin{aligned}V^n &= C/p \quad \text{and} \quad V = C^{1/n}/p^{1/n} \\ W &= \int_{p_1}^{p_2} V dp = C^{1/n} \int_{p_1}^{p_2} dp/p^{1/n} \\ &= C^{1/n} \left[\frac{p_2}{p_1} \frac{1}{1 - (1/n)} (p_1)^{1 - (1/n)} \right] \\ &= \frac{n}{n-1} (C)^{1/n} [(p_1)^{1 - (1/n)} - (p_2)^{1 - (1/n)}] \\ &= \frac{n}{n-1} [(p_1)^{1/n} V_1 (p_1)^{1 - (1/n)} - p_2 V_2 (p_2)^{1 - (1/n)}] \\ &= \frac{n}{n-1} (p_1 V_1 - p_2 V_2) = \frac{n}{n-1} R(T_1 - T_2)\end{aligned}$$

or,

$$-W = \frac{n}{n-1} R(T_1 - T_2)$$



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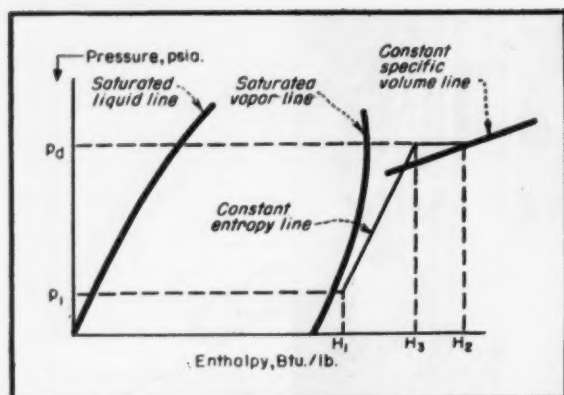


Fig. 6—Pressure-enthalpy diagram for estimating V_s .

where $-W$ represents work put into the system during compression.

In an earlier section we derived an expression for an adiabatic flow compression of an ideal gas (see *Chem. Eng.*, Dec. 1953, p. 214): $-W = \Delta H = C_{pm}(T_2 - T_1)$. But $C_p - C_v = R$ and $C_p/C_v = k$. Thus $(C_p/C_v) - (C_v/C_v) = R/C_v$. Now $k - 1 = R/C_v$ and $R/C_v = Rk/(k - 1)$. So $k - 1 = Rk/C_v$ and $C_v = Rk/(k - 1)$.

Therefore $-W = C_{pm}(T_2 - T_1) = Rk(T_2 - T_1)/(k - 1)$.

We could develop a polytropic factor. This would allow us to use heat capacity and temperature rise to calculate actual polytropic processes. Because the following relations hold:

$$\begin{aligned} \text{Adiabatic} - W &= C_{pm}(T_2 - T_1) \\ \text{Adiabatic} - W &= kR(T_2 - T_1)/(k - 1) \\ \text{Polytropic} - W &= nR(T_2 - T_1)/(n - 1) \end{aligned}$$

and by the definition of n ,

$$C_{pm} = kR/(k - 1) \quad \text{and} \quad k/(k - 1) = C_{pm}/R$$

Therefore,

$$n/(n - 1) = C_{pm}(\text{Eff.})(T_2 - T_1)$$

So, for the polytropic process,

$$\begin{aligned} -W &= (C_{pm}/R)(\text{Eff.})(R)(T_2 - T_1) \\ &= C_{pm}(\text{Eff.})(T_2 - T_1) \\ -W &= \text{Efficiency} \times \Delta H \end{aligned}$$

Then, if we know the efficiency, the work needed for the polytropic process can be determined in the same way as for the adiabatic process. But in either case we have to calculate T_2 .

$$\begin{aligned} T_2/T_1 &= (p_2/p_1)^{R/C_p} = (p_2/p_1)^{(k-1)/k} & (\text{adiabatic case}) \\ T_2/T_1 &= (p_2/p_1)^{(n-1)/n} & (\text{polytropic case}) \\ T_2 &= T_1(p_2/p_1)^{(n-1)/n} \\ -W &= (n/(n - 1))(R)(T_2/T_1) \\ -W &= (n/(n - 1))(R)[T_1(p_2/p_1)^{(n-1)/n} - T_1] \\ -W &= (n/(n - 1))(RT_1)[(p_2/p_1)^{(n-1)/n} - 1] & (\text{poly.}) \\ -W &= (k/(k - 1))(RT_1)[(p_2/p_1)^{(k-1)/k} - 1] & (\text{adia.}) \end{aligned}$$

The polytropic equation, above, can be adapted for non-ideal gases by making use of the compressibility factor and the law of corresponding states.

$$-W = \frac{n}{n - 1} (p_1 V_1) [(p_2/p_1)^{(n-1)/n} - 1]$$

Since $p_1 V_1 = z_1 R T_1$, we may write the approximation:

$$-W = \frac{n}{n - 1} (z_1 R T_1) [(p_2/p_1)^{(n-1)/n} - 1]$$

And this approximate expression can be made even simpler.

$$\text{Let } \beta = n/(n - 1) [1 - (p_2/p_1)^{(n-1)/n}]$$

$$W = z_1 R T_1 \beta$$

Instead of solving for β every time, a simple plot is made using (p_2/p_1) and β as coordinates and various values of n as parameters. (See Fig. 7.)

How to Solve Centrifugal Compression Problems

The method of solving a centrifugal compression problem is based on a given impeller that has a polytropic efficiency and that produces a given polytropic head. These two items are determined by a test for each stage. And a stage consists of a guide vane, the impeller itself, a diffuser, and a return channel.

Efficiency varies with the loading (underloaded, fully loaded, or overloaded) and the head depends on both the loading and the speed. Actually the head varies with the square of the speed. The equation, $n/(n - 1 = k/k - 1) \times \text{Efficiency}$, is used to find the polytropic factor, n .

In dealing with gases and gas mixtures, k is known or can be calculated using mean heat capacities over the temperature range involved, and for the equation above the exponent can be determined. Knowing the head available in a given stage, we can calculate the compression ratio that can be developed. $W = z_1 R T_1 \beta$ and $\beta = W/z_1 R T_1$. With a value of β known, we read p_2/p_1 directly from the curves of Fig. 7.

Then we repeat this method for each stage using the proper value of z and T . Enough impellers are used to reach the desired discharge pressure. In some cases two or more compressor casings must be used. Then intercooling is used to reduce the temperature of the gas between stages. This saves head and horsepower.

Head is the work done on 1 lb. of the gas. Then, knowing the weight flow:

$$\text{Gas Horsepower} = \frac{(\text{lb./min.})(\text{Head})}{(33,000)(\text{Efficiency})}$$

For estimating, assume a polytropic efficiency of 70 to 78 percent. The larger the compressor the higher the efficiency. Add 10 to 30 horsepower for losses.

Table II—Molal Heat Capacities, MC_p , Btu./(lb.-mole) ($^{\circ}\text{R}$)

Chemical Formula	Gas	50 $^{\circ}\text{F}$.	100 $^{\circ}\text{F}$.	150 $^{\circ}\text{F}$.	200 $^{\circ}\text{F}$.	250 $^{\circ}\text{F}$.	300 $^{\circ}\text{F}$.
CH ₄	Methane	8.38	8.65	8.97	9.30	9.55	10.25
C ₂ H ₂	Acetylene	10.22	10.69	11.13	11.53	11.90	12.21
C ₂ H ₄	Ethylene	10.02	10.68	11.40	12.08	12.75	13.41
C ₂ H ₆	Ethane	12.13	1.296	13.78	14.68	15.50	16.33
C ₃ H ₆	Propylene	14.75	15.77	16.80	17.88	18.90	19.91
C ₃ H ₈	Propane	16.82	18.21	19.58	20.90	22.24	23.57
C ₄ H ₆	Butylene	20.45	21.94	23.41	24.86	26.28	27.64
C ₄ H ₈	Butene	20.44	22.09	23.67	25.18	26.62	28.04
C ₄ H ₁₀	Isobutane	22.10	23.96	25.82	27.62	29.39	31.11
C ₄ H ₁₀	n-Butane	22.83	24.51	26.16	27.80	29.42	31.00
C ₅ H ₁₂	Isopentane	27.59	29.90	32.20	34.44	36.60	38.70
C ₅ H ₁₂	n-Pentane	28.27	30.30	32.39	34.41	36.45	38.47
C ₆ H ₆	Benzene	18.43	20.47	22.50	24.46	26.33	28.17
C ₆ H ₁₄	n-Hexane	33.87	36.23	38.70	41.06	43.49	45.88
C ₇ H ₁₆	n-Heptane	39.52	42.28	45.00	47.76	50.54	53.31
NH ₃	Ammonia	8.355	8.568	8.800	9.020	9.234	9.447
Air		6.9478	6.9585	6.9725	6.9900	7.012	7.0375
H ₂ O	Water	7.984	8.03	8.071	8.119	8.170	8.226
O ₂	Oxygen	6.992	7.028	7.077	7.120	7.175	7.235
N ₂	Nitrogen	6.9548	6.9574	6.963	6.9718	6.9841	6.9995
H ₂	Hydrogen	6.8595	6.9055	6.9339	6.954	6.9681	6.9776
H ₂ S	Hydrogen Sulfide	8.091	8.182	8.269	8.359	8.450	8.541
CO	Carbon Monoxide	6.9567	6.9634	6.9728	6.9855	7.0046	7.0276
CO ₂	Carbon Dioxide	8.705	9.004	9.288	9.555	9.821	10.050

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So fast is the Turba-Film Evaporator action that proper heating is done in seconds. Eliminates hydrostatic head. No localized overheating. Eliminates vapor binding on heat transfer surface. Maintains high over-all heat transfer coefficient of from 100 to 500!

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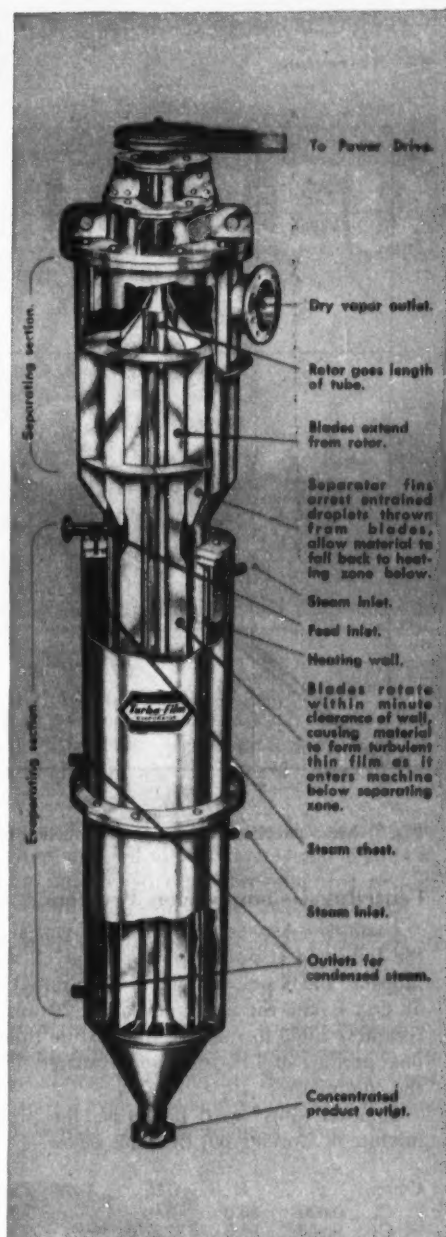
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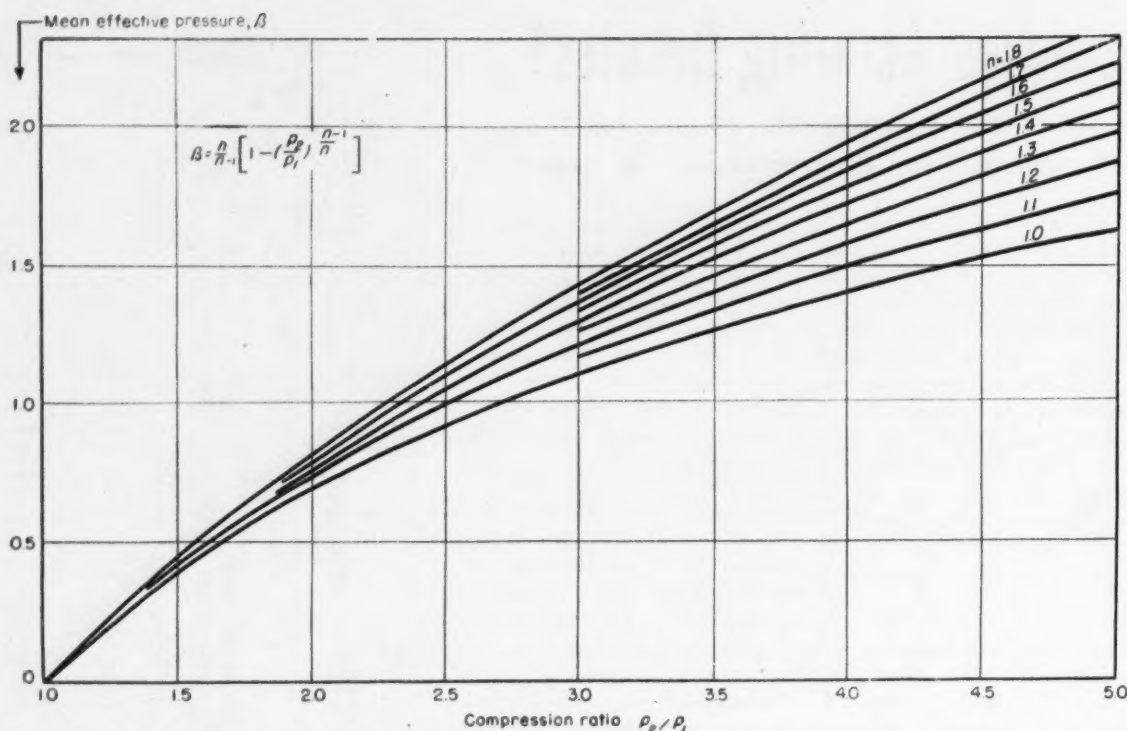
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Type of Industry.....Product.....

Fig. 7—Mean effective pressure, β , is a function of the compression ratio.

Centrifugal Compression Problem

Example—Assume that a petrochemical feedstock has the following composition: 2 percent ethane, 95 percent propane, and 3 percent butane. The initial temperature is 50 deg. F. and the initial pressure is 20 psia. We want to compress 2,000 lb./min. of the mixture from 20 psia. to a final pressure of 135 psig. (approximately 150 psia.). Size the compressor.

Solution—First we'll determine the properties of the mixture by working out the table below.

Comp.	y	M	yM	T _c	p _c	yT _c	yp _c
C ₂	0.020	30.0	0.60	550	708	11	14
C ₃	0.950	44.0	41.80	666	617	634	586
C ₄	0.030	58.1	1.74	766	551	23	17
Average . . .		44.14				668	617
		$T_r = 510/668 = 0.763$		$p_r = 20/617 = 0.0324$		$z_1 = 0.969$	

The next step is to find the k value for the mixture, which is done by using the molal heat capacities and the relationship $k = C_p / (C_p - 1.99 z)$

Comp.	y	C _p at 50° F.	yC _p
C ₂	0.020	12.13	0.24
C ₃	0.950	16.82	16.00
nC ₄	0.030	22.83	0.69
Average .			16.93

$$k = \frac{16.93}{16.93 - (1.99)(0.969)} = 1.13$$

We can determine other values, also, $R = 1,544/44.14 = 35$.

$$V_1 = \frac{z_1 RT_1}{p} = \frac{(0.969)(35)(510)}{(144)(20)} = 6.0$$

Now we can find the head using the equation $W = z_1 RT_1 \beta$, and $n/(n-1) = k/(k-1) \times \text{Efficiency}$.

The inlet volume is about 12,000 cfm. This means that a medium size centrifugal compressor will be required and its efficiency can be assumed to be about 75 percent.

$$n/(n-1) = (1.13/0.13)(0.75) = 6.52$$

$$\frac{n}{n-1} = 1.18$$

$$p_1/p_2 = 150/20 = 7.5$$

$$\beta = 2.36$$

$$W = (0.969)(35)(510)(2.36) = 40,800 \text{ ft.}$$

$$(2,000)(40,800)/(33,000)(0.75) = 3,300 \text{ gas horsepower}$$

$$25 \text{ friction hp. (assumed)}$$

$$3,325 \text{ bhp. required}$$

The worked out solution above emphasizes the importance of calculating the ratio of the specific heats, k. The fraction contributions of the individual components must be considered. Table II gives molal heat capacities for some of the more common gases.

This completes Compression and Expansion presented in three parts—Dec. 1953 and Jan., Feb. 1954.

Next Month—Chemical Equilibrium—I will discuss heat of reaction, its changes with pressure and temperature, theoretical flame temperature, incomplete reactions, and theoretical explosion pressures.

Reprints—CE Refresher discussed Thermodynamics Principles in Sept., Oct. and Nov. 1953. A combined reprint can now be ordered. See page 474.

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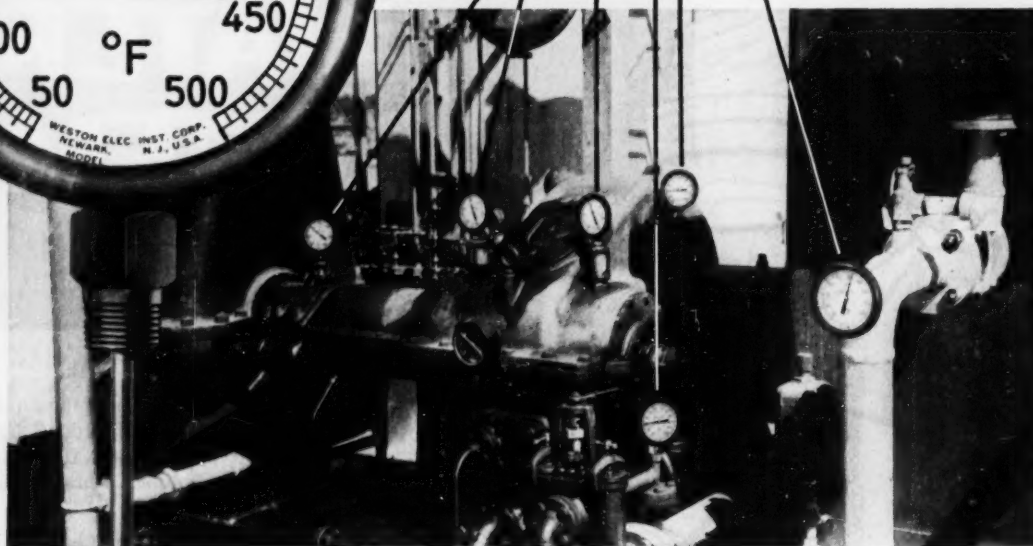
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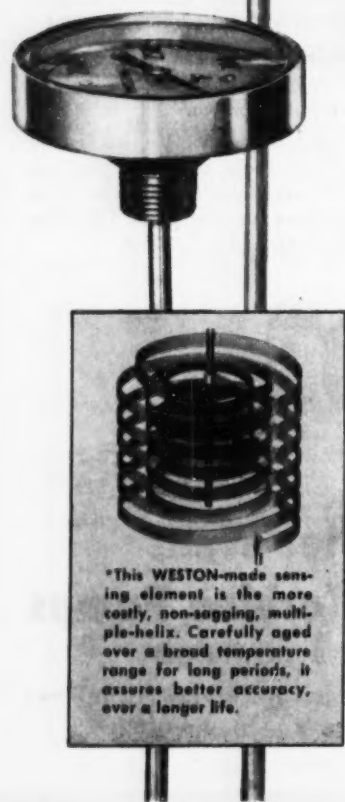
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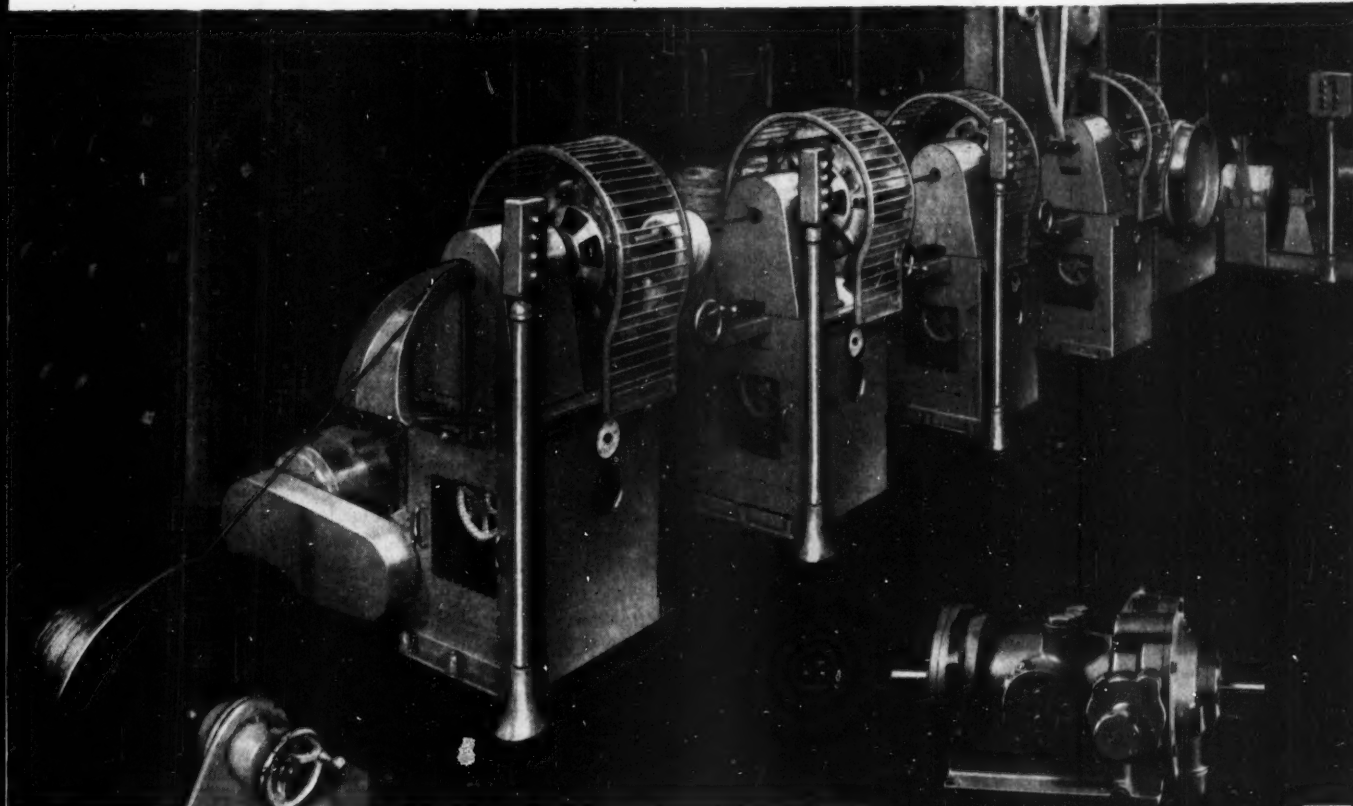
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This machine was designed and built by the company's own men some years ago. For optimum

performance, the speed of the heads should be easily and independently variable and the direction of rotation instantly changeable because the lay and pitch of the wrappings must be varied according to the requirements of the run. Moreover, the inside contour of the tube formed by the wrapping should be smooth and uniform so as to avoid setting up echo waves that interfere with transmission and vitiate signal strength.

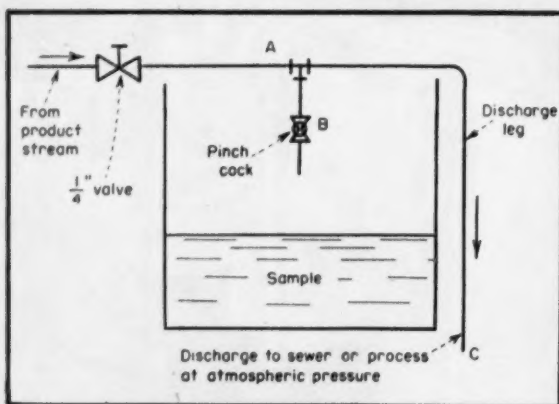
Because of these requirements, a new drive was installed something over 4 years ago. A line shaft drives five Oilgear Fluid Power Transmissions, one at each machine head and the capstan.

The results were these: uniformity and control of tension are so good, the machine runs at 4 times its former machine speed; it is easy to vary speed and direction of rotation of each individual head; eccentric heads gave way to concentric heads, and supply spools are now loaded to full capacity instead of $\frac{1}{4}$ th to $\frac{1}{4}$ th as before; the machine is stopped less frequently for loading. Maintenance on the former drive was involved and frequent—on the Oilgear equipment it has been simple and negligible.

There is some reason to suspect that Oilgear Fluid Power with its wide range of advantages may solve some of *your* machine design problems and make the results very pleasing and profitable. Why don't you really find out? **THE OILGEAR COMPANY, 1579 West Pierce Street, Milwaukee 4, Wisconsin.**



OILGEAR



Pulsating Sampler for Liquid Stream Averts Plugging by Solids

G. E. SCHUMANN, Chemical Engineer, Process Dept., Westvaco Chemical Div., Carteret, N. J.*

★ November Contest Prize Winner

In continuously sampling a flow of process liquid, we have found a slightly opened valve dripping into a container to be ineffective because suspended solids, if present, will plug the small opening and stop the flow of sample. The device sketched above is simple, easily assembled, and does not become plugged because it pulsates automatically as it operates.

A portion of the liquid to be sampled is taken off from the product stream through a $\frac{1}{4}$ -in. valve and carried in rubber tubing to a barrel collecting the sample. There a tee allows a slow drip of sample, while the major part of the flow continues on to the sewer, or back to process at atmospheric pressure. When the unit is operated the valve is throttled until the flow at the discharge pulsates rapidly and the tee and bleed-off can be heard to make a gurgling noise. The pinch cock B is adjusted until the sample drips off at a slow rate; the system then operates without attention.

The principle of the sampler is as follows: When the

* Present address: Process Engineering Dept., Marathon Corp., Menasha, Wis.

dimensions of the system are in balance, the flow of fluid at point A is somewhat less than the flow in the discharge leg would be, due to gravity, if the discharge leg were full. When this occurs, air is drawn in through the pinch cock at B, breaking the siphoning action. Because of the entrained air, the effective density of the liquid in the gravity leg decreases as air is drawn in, and the total flow at C decreases. A small quantity of sample starts to flow at the pinch cock B, and the whole cycle is repeated. Drawing air in through the bleed-off immediately dislodges any particles which might tend to collect, and keeps the sampler in operation. The cross-sectional area of flow at B is determined by the flow through the sampler and the surface tension of the fluid handled, hence the pinch cock is set to give the proper sampling rate after the flow rate has been established.

Using $\frac{1}{4}$ -in. fittings and a discharge leg of about 3 ft., the sampler will flow 0.2-1 gpm., with the collected side stream as small as 5 gal. per day (0.3 percent). Several such units have been in service for some time taking fluid from process lines or small pumps. Occasionally the valve bleeding from high pressure to sampler pressure becomes plugged, but this opening is relatively large and such plugging occurs only infrequently.

If You Keep Article References—Here's a Simpler Method

F. J. MCADAM, Chemical Engineer, E. I. du Pont de Nemours & Co., Grasselli, N. J.

All who read the technical journals are faced with the problem of making some form of record of articles of particular interest, rather than trust to memory or to a time-consuming search through indexes and abstracts when need arises. Common methods (not counting notes on the backs of envelopes!) are files of cards, of clippings, or both.

Instead of these I prefer another method which gives quick access to references with a minimum of clerical effort. Simple entries are written in a pocket loose-leaf notebook, one or several pages representing a subject such as "Distillation" or "Statistics," marked at the corner of the page. Titles are not necessarily the published ones, but should rather be tailored to flash key words to the reader's

★ December Contest Prize Winner

"How to Modify Plate-Type Distilling Columns for Higher Feed Rates."

A prize of \$50 in cash will be awarded to Leonard Steber, E. R. Squibb & Sons Div., Mathieson Chemical Corp., New Brunswick, N. J. Mr. Steber's article will be published in the March Plant Notebook.

\$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award \$50 cash each month to the author of the best short

article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the second following month and published the third following month.

\$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudget to determine the year's best Plant Notebook article, which will then be awarded an additional \$100 prize.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other

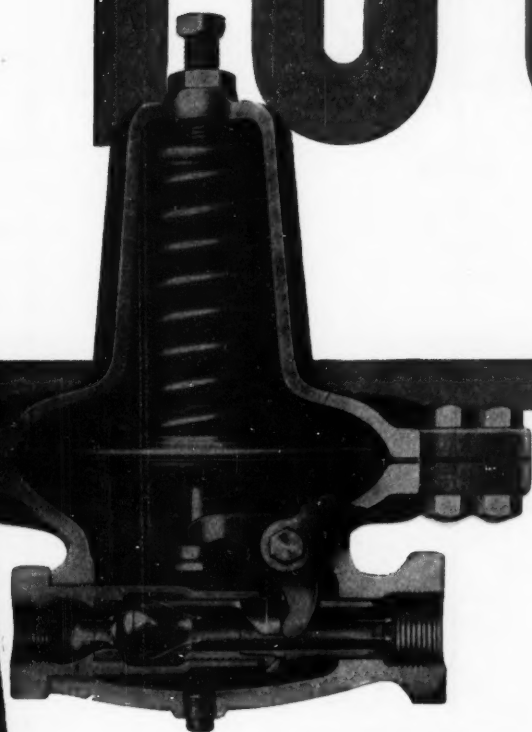
than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Articles which are acceptable but are not winners will be published at regular space rates (\$10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.

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mind, reflecting his interests. Typical entries might be:

Bubble Tray Design.

Zenz, *Ch. Eng.*, 59 (4) 169 (April '52)

Computers, Statistics and Mathematics—Review.

Rose et al, *IEC*, 45, 933 (May '53)

The notebook can be carried about as needed, and used

as its owner's personal index to any technical library, in addition to any other use he may make of the book. In consulting it, he can survey 5 to 12 entries on a page at a glance. In most cases three or four pages will cover a subject. Contrast this to 25 or 50 index cards or an equal number of clippings, bulkier, less portable and representing more preparation time in the first place.

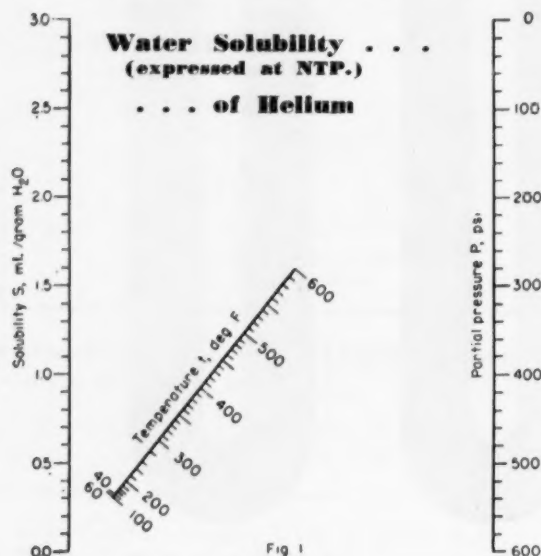


Fig 1

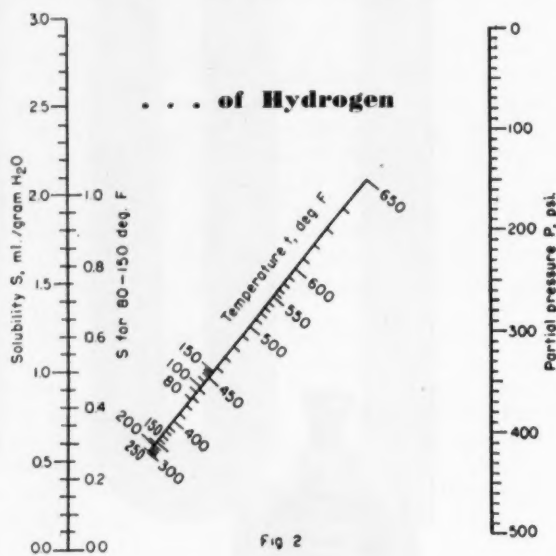


Fig 2

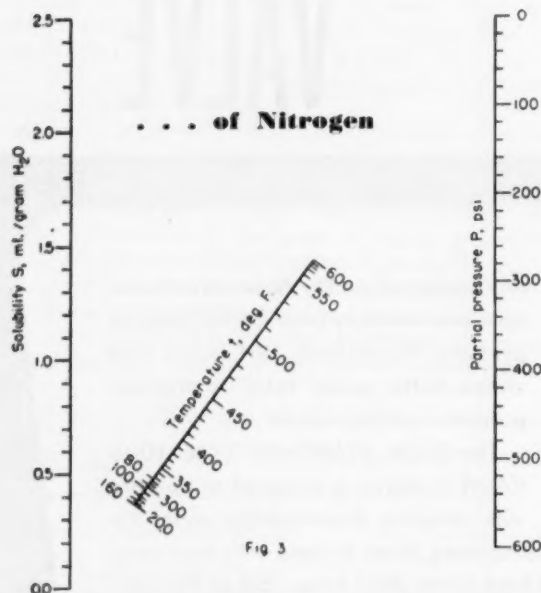


Fig 3

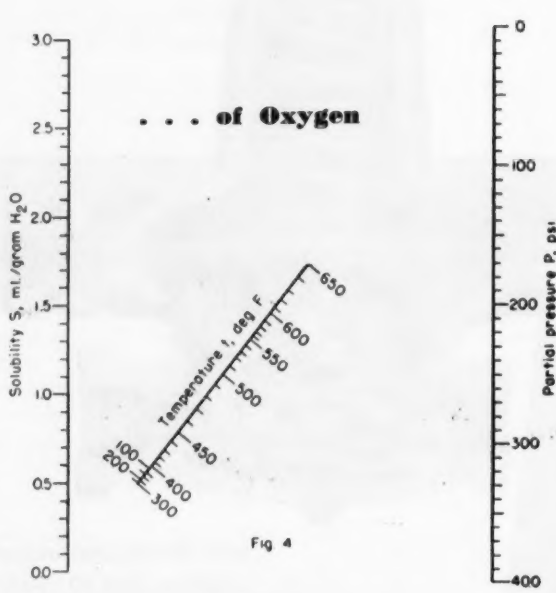


Fig 4

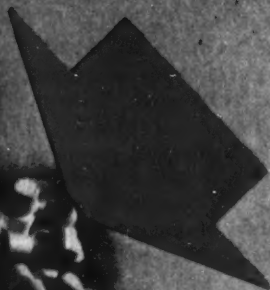
Charts Give Water Solubility of Helium, Hydrogen, Nitrogen and Oxygen

DALE S. DAVIS, Professor of Chemical Engineering, Virginia Polytechnic Institute, Blacksburg, Va.

Recent experimental investigations¹ on the solubilities of helium, hydrogen, nitrogen, and oxygen in water at temperatures between 50 and 650 deg. F., and at partial pressures of 0 to 600 psi., confirm the application of Henry's law and serve to substantiate the published values of K ($K = P/N$, where P is the partial pressure of the

gas, psi., and N is the mole fraction of gas dissolved in water).

These confirmatory data appear as straight, convergent isotherms on plots of solubility against partial pressure, and as curved isobars on plots of solubility against temperature. Since neither presentation permits accurate and



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convenient interpolation of solubilities, the accompanying nomographs were constructed to extend the utility of the original data. They enable easy, visual interpolation of all three variables on closely graduated scales.

In the Henry's law equation, $K = P/N$, where $N = 18,016 S/22,400 = 8.04 (10)^{-4} S$, so that $8.04 (10)^{-4} K = P/S$, where S = solubility of the gas, in milliliters at normal temperature and pressure per gram of water. Since this latter equation is in the form of $f(x) = F(y)/\phi(z)$, the charts were constructed by methods described previously². The values of K for each gas appear in abbreviated form in the table. They were computed from the literature³ by means of extensive application of the schedules for interpolation through use of the Lagrange equation^{2,4}.

Values of $10^4 K$ Interpolated by Lagrange Equation

Temp., Deg. F.	O ₂	H ₂	He	N ₂
50			21.17	
80	6.58	10.65	21.71	13.44
100	6.74	9.56	21.42	15.14
150	7.22	8.36	19.10	17.96
200	7.72	8.50	16.00	18.28
250	8.10	9.13	12.66	16.84
300	8.15	9.30	9.31	14.63
350	7.69	8.22	7.12	11.95
400	6.66	6.55	5.56	9.10
450	4.55	4.40	4.42	6.41
500	2.77	2.90	3.56	4.18
550	2.12	2.31	2.80	2.74
600	1.74	1.86	2.20	2.38
650	1.22	0.89		

The use of the charts is illustrated as follows: What is the solubility of helium in water at 500 deg. F. when the partial pressure of the gas is 400 psi.? In Fig. 1 connect 400 on the P -scale with 500 on the t -scale, produce the index line (not shown) to the S -scale and read the desired solubility as 1.4 ml. of helium per gram of water. Note that the solubilities of these gases attain minimum values at temperatures of 80 to 250 deg. F. and that this situation is reflected in graduations that increase in opposite directions, found on opposite sides of the t -axes. In the case of hydrogen, solubility increases as temperatures rise from 80 to 150 deg. F., decreases as temperatures rise from 150 to 300 deg. F., and further increase as temperatures rise above 300 deg. F. To provide for this situation, a special scale for solubility at temperatures from 80 to 150 deg. F. appears on the right side of the solubility axis in Fig. 2.

REFERENCES

- (1) Davis, D. S., "Empirical Equations and Nomography," Chap. VIII, McGraw-Hill Book Co., Inc., New York, 1943.
- (2) *Ibid.*, Chap. II.
- (3) Davis, D. S., *Chem. Eng.*, **60**, 198 (Nov. 1953).
- (4) Pray, C. A., C. E. Schweickert, and B. H. Minnich, *Ind. Eng. Chem.*, **44**, 1146-51 (1952).

Here's a Tip for Emergency Cleaning of Piping

E. J. Erwood, Research Director, Beta Research Laboratory, Chicago 23, Ill.

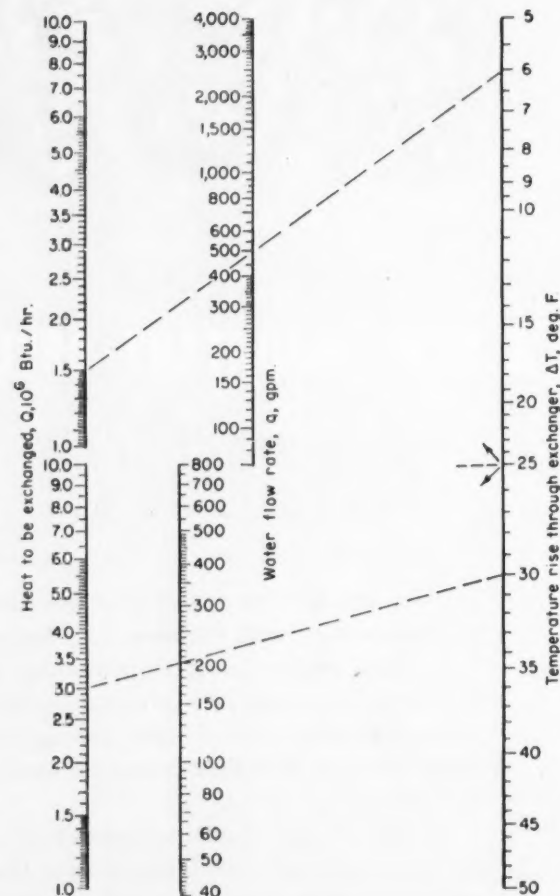
It often happens that the chemical engineer is faced with a plugged plant drain, which will not yield to conventional methods of cleaning, such as ramming. Here is a trick we have used in our plant with such success that it is worth passing along.

Take a piece of steel strap of the kind used to bind large boxes and lumber framework. It measures about 1½ in. across, by ¼ in. thick and can easily be converted

by the shop into a spinning drain cleaner which can be operated by a ½-in. electric drill. Hammer one end of the strap into cylindrical shape around a drill bit, for chucking in the drill. Bend the other end through 180 deg., about 4 in. from the end.

This device should never be operated in the open or in pipes exceeding about 10 in. in diameter, or it will twist and become ineffective. Strap up to 8 ft. in length has been used in 6 in. piping with excellent results.

One advantage of this method is that it uses scrap material commonly found in plants, without need for expensive power cleaning devices.

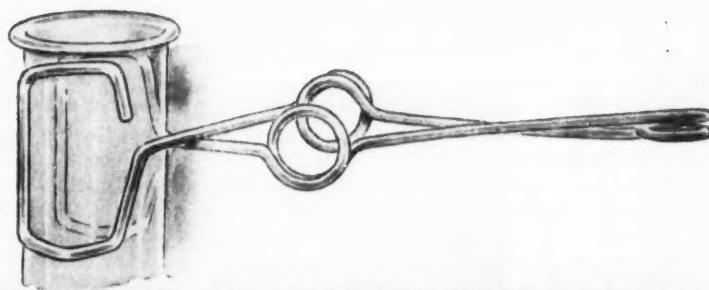


Nomograph Gives Water Rate Of Heat Exchangers

BENJAMIN SMITH, Process Engineer, Koppers Co., Pittsburgh, Pa.

In determining plant utility needs the engineer must often find the water rates for a large number of heat exchangers. For this purpose he knows the heat to be transferred in each exchanger, and the temperature rise of the water. Calculating the water rate is not difficult, but becomes time consuming. The double nomograph given here solves the problem in short order.

Note that the chart is actually two charts joined at a ΔT value of 25 deg. F. If the temperature rise is less than



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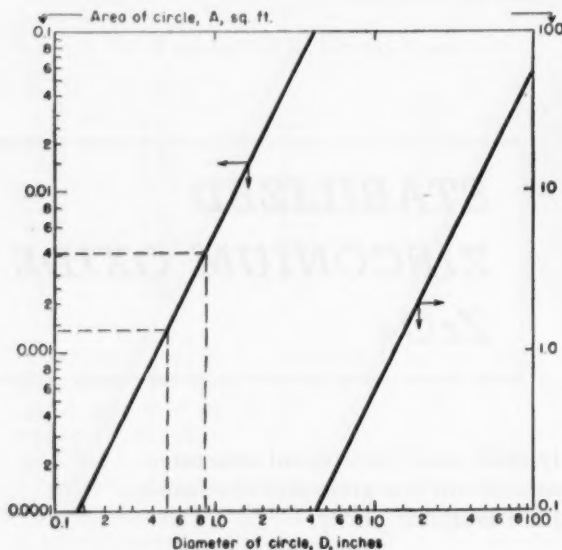
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25 deg., use the upper set of Q and q scales. If 25 deg. or more, use the lower set.

Here Q is the heat to be transferred in millions of Btu. per hr., ΔT is the temperature rise through the exchanger and q is water flow through the exchanger, gpm., required for the specified heat exchanger duty. To use either portion of the chart, align the known values of ΔT and Q and read the value of q where the straightedge meets the q -scale. For example, if ΔT is 6 and Q is 1.5, then $q = 500$ gpm. If ΔT is 30 and Q is 3, then $q = 200$ gpm. The range of either chart can be changed by multiplying or dividing all scales by 10, 100 or 1,000, etc.



Log-Log Plot Speeds Up Finding Circle Areas

GUSTAVE J. WEISS, Chemical Engineer, Vitro Corp. of America, New York, N. Y.

The log-log plot above is useful in many engineering calculations for quickly finding the area of a circle in square feet, when the diameter is expressed in inches. It can be used to find the circular cross-sectional areas of tubes, pipes and cylinders, for determining flow areas, capacities and flow rates in cubic feet per sec. at a flow velocity of 1 fps. It is especially useful for determining the area between two concentric tubes, as in a double-pipe heat exchanger, or the annular area between the outside of a distillation tray riser and the inside of the bubble cap.

The chart can be drawn for any desired range of cross sections or diameters by choosing appropriate scales on the paper. It can quickly be drawn to large scale for accurate use. Here is how:

The cross-sectional area of a circle in square feet, in terms of the diameter in inches, is $A = (\pi/4)(D/12)^2$ where A is in sq. ft. and D is in inches. Simplifying, $A = 0.00545 D^2$. Taking logs of both sides, $\log_{10} A = 2 \log_{10} D + \log_{10} 0.00545$. A plot of A vs. D on log-log paper is a straight line of slope 2 which (since $\log_{10} D = 0$ when $D = 1$) has an intercept of 0.00545 on the $D = 1$ axis. To construct it it is only necessary to draw a line of

slope 2 on log-log paper, through the point ($D = 1$, $A = 0.00545$).

Suppose it is desired to know the annular area between two concentric steel tubes, both 16 ga. B.W.G. The outer tube is 1 in. O.D. and the inner tube is 0.5 in. O.D. Available tables show the inner diameter of the large tube as 0.87 in. With the chart re-plotted on regular log paper (for greater accuracy) we find the area of the 0.87 in. circle to be 0.00416 sq. ft., and the area of the 0.5 in. circle to be 0.00139 sq. ft. Hence the annular area between the tubes is $0.00416 - 0.00139 = 0.00277$ sq. ft. Computing for comparison from the formula given above we get the same result, indicating that the log-log plot method is as accurate as slide-rule computation, in addition to being much faster.

Pressure Switch Serves as Simple Level Control

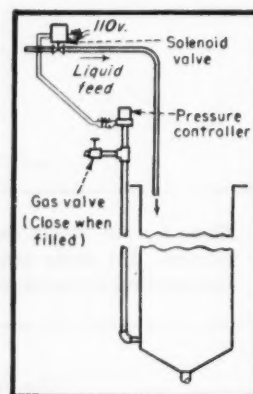
R. VOLTERRA, General Plate Div., Metals & Controls Corp., Attleboro, Mass.

Oftentimes there are conditions such as violent agitation in a tank which make it impossible to use a float for level control. In a case of this type we wanted to control the level in a vertical leaching tank, operating at 90 deg. C., in which the agitation was violent. We developed a simple method of level control using two pieces of standard inexpensive apparatus.

As the sketch shows, a piece of stainless steel pipe $\frac{1}{4}$ in. in diameter and as long as the tank was welded near the bottom of the vessel and its top provided with a tee. To the vertical branch of the tee a Vaporstat L408A (made by Minneapolis-Honeywell) was connected. On the side outlet of the tee we provided a good, tight gas valve of small size. The Vaporstat, which is a simple pressure controller, operated a normal solenoid valve in the tank feed line.

The small gas valve is kept open while the tank is being filled, and is closed immediately when the desired level is reached. Thereafter, level changes in the tank will be reflected as pressure changes at the Vaporstat. Thus, when evaporation of the solution lowers the tank level about 2 in., the slight pressure drop in the vertical pipe will actuate the mercury switch of the pressure controller, energizing the solenoid valve and opening the feed line until the original level is reached. At that point, with the pressure back to normal in the vertical pipe, the solenoid valve is de-energized and the feed shut off.

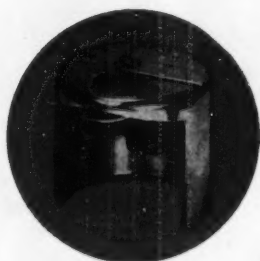
Operation of the control is entirely automatic. The valve can be placed far away from the vessel if necessary for convenience or safety, and the mercury switch, being hermetically sealed, is well protected against corrosion. The units are of low cost and the entire assembly is simple to install.



Here's a *Real*

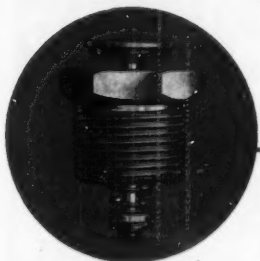
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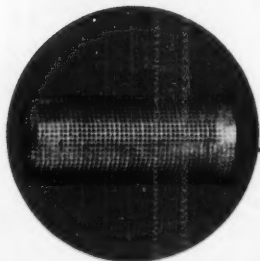
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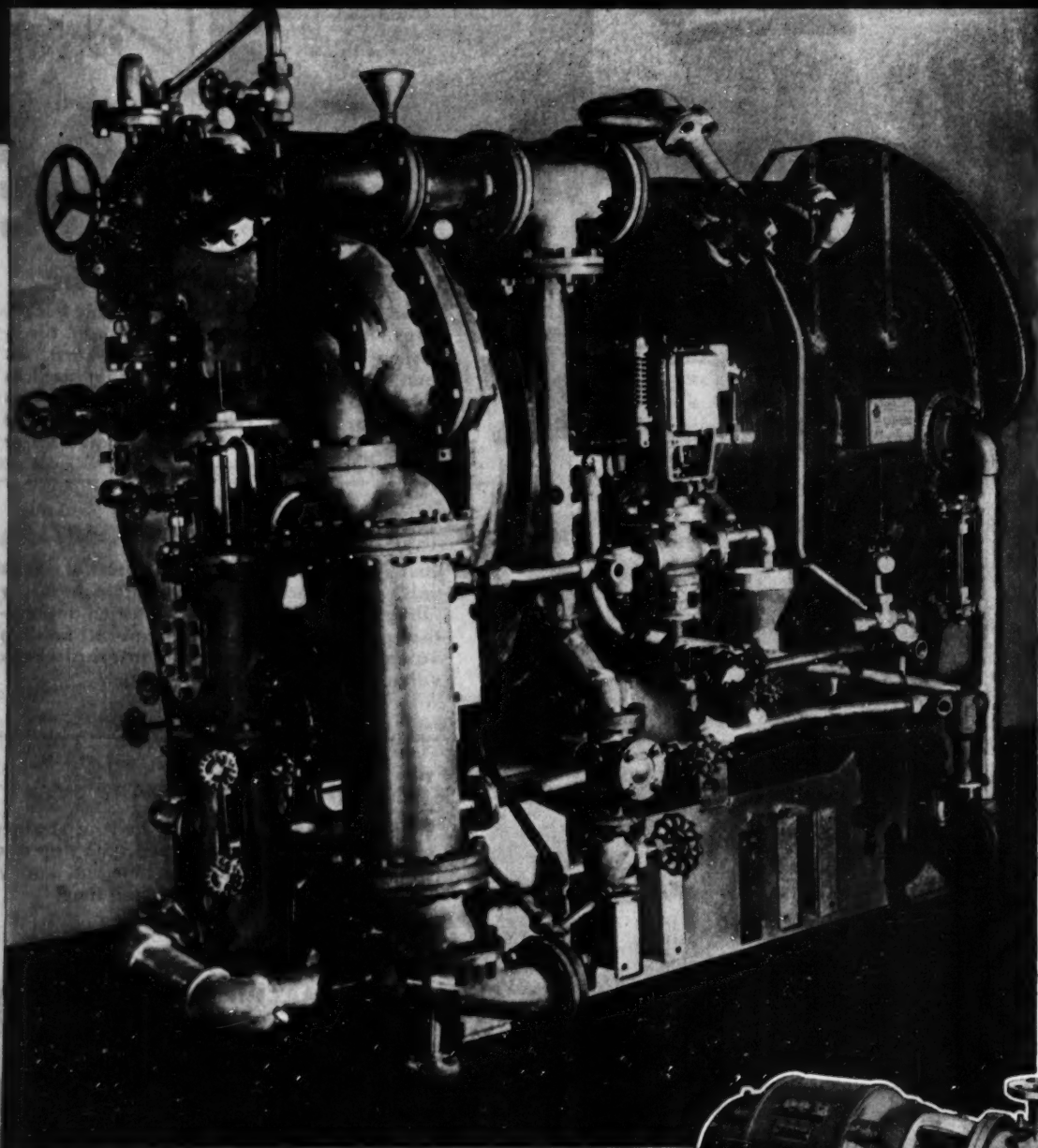


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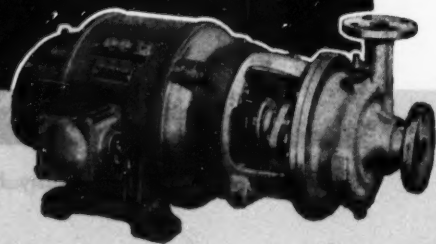
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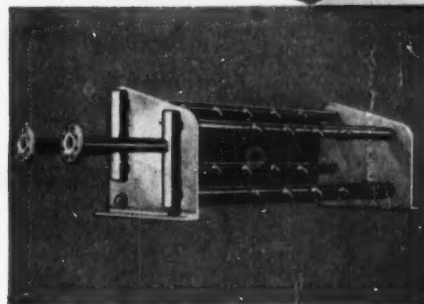
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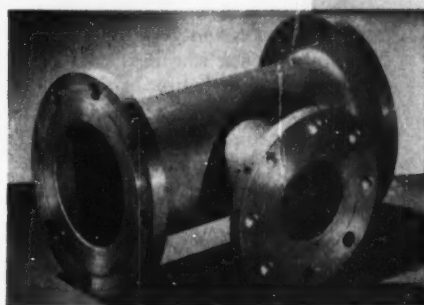
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You can also make full use of your technical knowledge. A non-technical jobber might suddenly find that a particular use for a product has vanished—and he's stuck with carloads of it. A technical man in such a spot can go into a plant and talk with fellow chemists and engineers, doing his own particular kind of market research, until he finds a place to unload the stranded product.

What Is a Jobber?

Jobbing chemicals means local storage for quick delivery in small lots. The function of the jobber is service. He must be able to make immediate delivery, usually on the same day the order is received. Usually the customer can buy directly from the manufacturer at as low a price as the job-

ber, but if he does so he must buy a carload and wait several days for delivery. In many cases he does not have the warehouse or tankage for the carload quantities, and in other cases he cannot wait for the shipment to reach him. At such times he calls on the jobber.

Generally, to be successful as a jobber, you have to meet these three conditions:

1. There must be a local market for less-than-carload business.
2. You must have enough capital to handle your needs for equipment, inventory and working capital.
3. You should be well known in your community, although in some cases this will take care of itself in time.

What Do You Need to Start?

Anyone going into jobbing must first decide what he wants to sell, and this will require a survey of the local market. The worst thing that can happen to any business is to have large sums tied up in inventory for which there are no buyers. It is sometimes best to start with only one item which is fairly easy to move and then grow as other opportunities develop.

One very successful jobber I know handled only one chemical—sulfuric acid—for years. But he handled it with great success. Now he has expanded into other lines.

In particular you should be cautious about installing expensive equipment suitable for only one common chemical—for example, a stainless steel

tank for nitric acid—unless sales of that chemical are assured. To prevent such a disaster, talk to the purchasing agents of the local plants. In nearly all cases, they will be interested and helpful.

It may be wise to arrange with manufacturers who have local warehouses themselves to sell doubtful items for a time from their stock, thus eliminating the risk of installing useless equipment or stocking slow-moving items. Of course, when this is done, the jobber's profit is much smaller, since he loses the advantages of bulk buying. In many cases you can arrange a contract calling for a certain rate of delivery of a given chemical before that chemical is stocked. In such cases, you, the jobber, must be sure that you can make good on your end of the bargain. This may mean a covering contract with the manufacturer supplying you.

Often a jobber will stock every chemical used by a particular plant, enabling him to provide complete service to that plant. This may mean carrying some low-profit items. In general, it is poor practice to sell anything at a loss to keep a foot in the door of a customer. The jobber will want to buy those chemicals which are manufactured at not too great a distance, since freight rates are an important part of his costs. On the other hand, manufacturers whose plants are further from a market than those of their competitors will equalize freight rates in order to compete.

(Continued)

G. M. GRIFFIN is a chemical engineer from MIT, '39. After production jobs with Socony-Vacuum, B. F. Goodrich, and time out for five years with the Army artillery in World War II, he and several associates recently got the Griffin Chemical Co. under way in Louisville, Ky.

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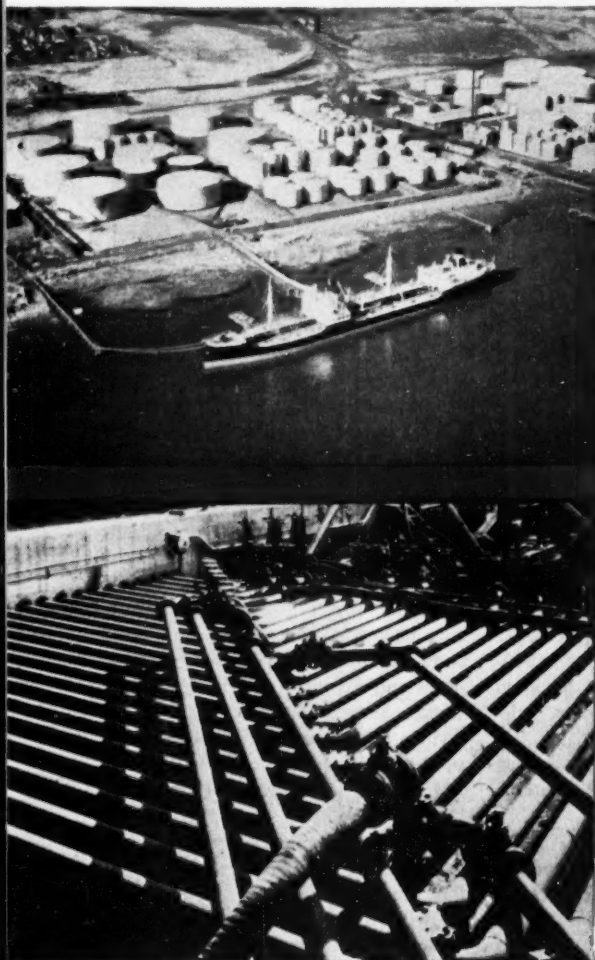
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Griffin selected a structurally sound, but run-down, building.



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The Equipment You'll Need

Having decided what you want to sell, you must next determine the equipment necessary for storing and handling. You will almost certainly want a warehouse of some description unless you are really running on a shoestring and plan to sell from somebody else's stock on commission or other arrangement. In such a case, you are really not a jobber at all.

If you are selling liquids, you will want some tanks large enough to store tankcar shipments to enable you to buy in bulk. You should be on a railroad spur so that box cars and tank cars can be spotted for you to unload. Since railroad spurs are not cheap whether the adjacent land is owned or rented, you would do well at this point to investigate truck and tank-wagon shipments with a view to eliminating the railroad. If a spur it must be, then there must be unloading lines from track to tanks, pumps or air compressor to move the liquid, and some sort of connection permitting several feet of contraction and expansion and a universal ball joint for changes in direction. Unloading with compressed air has the advantage of not exposing the driving mechanism to corrosive liquids.

You'll also need hand trucks for carboys, drums, bags and pallets, and a power lift truck if double-stacking of pallets is necessary. Then there will be a supply of empty carboys, and perhaps drums, with the name of the company marked on them. Wooden pallets which fit the lift-truck must be obtained. If you deliver, you will need at least one truck of about 1½ ton size unless you plan to use a public

hauler. A van-type truck is better because you can protect dry chemicals from the weather and you don't need tarpaulins. A loading dock of something like truck-bed height must be provided. And filling lines at the tanks are needed with some kind of quick-closing valve for accurate filling of carboys and drums. Scales should be used, of course, in packaging.

The Buildings You'll Need

The warehouse must be water-tight and have a good floor, preferably concrete. A small office can be enclosed in the warehouse itself for a telephone, correspondence and such records as may be kept. Needless to say, a warehouse for storage of chemicals should be well-ventilated.

Great care must be taken in the selection of equipment for handling and storing liquids. The concentrations may be critical. For instance, I wonder how many chemical engineers remember that 93 percent sulfuric acid may be handled in mild steel but that weaker solutions require lead-lining and stronger solutions may call for stainless steel. All points of contact must be protected; if rubber-lined equipment is used for muriatic acid, for example, then the flanges and valves must be lined as well.

Intelligent use of second-hand equipment can save you money. You must be careful, though, to inspect such equipment carefully and to learn the history of its use before buying. Tanks which have been used for gasoline, for example, present a safety hazard if any welding is done on them, since they remain a source of vapors long after they are empty.

The booklets of the Manufacturing Chemists Association on unloading tank cars, and handling and storage of various common chemicals are helpful and inexpensive. Study them carefully.

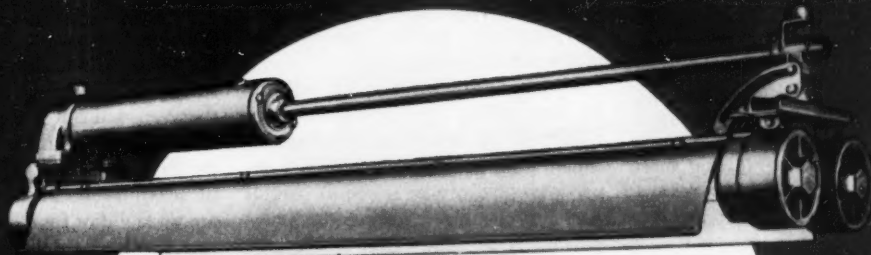
Should You Buy or Rent?

The relative advantages of owning or renting property and equipment have been discussed at great length especially since high income taxes have been the order of the day. Rent is an expense deductible for tax purposes and a firm in the high bracket should always consider the possible saving from renting real estate or motor vehicles. The jobber who is just getting started will be more interested in cutting down his investment through rentals than in the tax problem. If he borrows money to buy property or equipment, his interest will also be a deductible expense. Whether to buy or to rent will depend upon the individual case and no general rule can be laid down. Our own firm happened to find an ideal piece of ground on a railroad spur for sale at a reasonable price, so we decided to buy.

One point to remember in favor of owning is the difficulty of moving tanks and piping once they have been installed.

With regard to trucks, it is sometimes wise to defer purchase for a while and use a public hauler if one is available. This eliminates the depreciation charges on one or more idle trucks while the business is getting started and sales are slow. Should the hauler not provide prompt service, however, the contract should be ter-

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Send for your copy of Bulletin 2565, "LIGHT! Protect Your Property."

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"In selling liquids you will want tanks large enough to let you buy in bulk."

minated immediately, before customers are lost by slow delivery.

The Capital You'll Need

Financing the business, of course, depends upon the individual case. The entrepreneur may be able to attract one or more partners, active or silent, to provide some of the capital. In general, the corporate form is not suitable for a new business which is apt to be quite small, because of double taxation and the numerous regulations which apply. There is one considerable advantage to incorporation, however. And that is the fact that the owners are liable only in the amount of the assets of the corporation. Chemical companies are often the target of damage suits. If there is a partnership, there should be a written agreement among the partners drawn up by a lawyer and covering such contingencies as liquidation, death of a partner, and changes in organization.

It is very important to provide enough working capital to get the business on its feet after the plant has been set up. This means enough cash for the initial inventory plus enough for several months of very slow sales. Remember that when chemicals are purchased in carboys or drums, the deposit on the containers will be several times the cost of the chemicals themselves. It is said that more businesses fail for lack of working capital than for any other reason. If real estate and equipment are owned by the jobber, they may be used as security for a bank loan.

The Expenses You'll Meet

The principal items of expense will be those of any business—rent (unless property is owned), wages, interest, insurance, taxes, utilities, depreciation, maintenance and motor vehicles. The

jobber must carry fire insurance both on his warehouse and its contents. Your insurance agent can show you what alterations to make in your building, heating system, etc., to obtain the lowest rate. You will, of course, want to carry some form of workman's compensation, public liability and motor vehicle liability.

Your monthly utilities bill will not be large unless you heat your warehouse, which will not be necessary usually. Chemicals susceptible to damage from cold can be stored in a small heated room in the warehouse. Maintenance is not high except in the case of such items as acid pumps and lines and sometimes trucks. You will probably want to depreciate your equipment just as fast as the Collector of Internal Revenue will permit, especially that which is exposed to corrosive liquids. Advertising is of limited value to the chemical jobber; a small space in the classified section of the telephone book may suffice.



"A van-type truck is better; you can protect dry chemicals from the weather."

Rail Vs. Truck Shipments

The rail service, if available, may be of different types. Some tracks are private and are open to any road, while others are "team tracks" and may be used only for shipments over a particular line. The jobber, or for that matter, anybody who wants to use a rail spur, should find out ahead of time if the spur is open to shipments from all directions before he buys or leases the adjacent ground. If most of his carloads will come from Florida, he will certainly not be interested in a siding which is open to the Union Pacific and no other line. He will also be interested in the demurrage charge which is made when a car stands on a siding longer than a specified time, for example 48 hr., as he may expect

to have trouble in unloading from time to time, whether from pump failure, lack of space in his own tanks, or other cause.

In certain cases, truck shipments may be desirable. For example, a load of filled carboys in a truck is sometimes an economical means of transportation where the jobber has no suitable storage tank. (Bear in mind that you will have to pay the freight on the empty carboys going back to the factory.) Tank wagon shipments of acid may be desirable when there are no facilities for handling a railroad carload. Faster delivery can often be obtained by truck.

In general, the jobber will not have the storage capacity to justify shipments by water.

The jobber is no exception to the rule that the chemical industry requires a larger investment for each job than any other business. This is particularly true if your warehousemen can double as truckdrivers, which frequently happens. If you can use a typewriter and keep a simple journal, ledger, payroll record, and stock record, then you can dispense with the services of a stenographer and bookkeeper. It is very important, however, that someone be near the telephone at all times, since most of the orders will come in that way. Some jobbers have a full-time salesman calling on the trade and others make a few calls themselves when they think necessary. Since shipments will nearly always be received from outside the jobber's state, the firm is considered to be engaged in inter-state commerce and subject to the wage-and-hour laws of the federal government.

Other Questions Will Come Up

Relations with the manufacturing company or companies supplying the

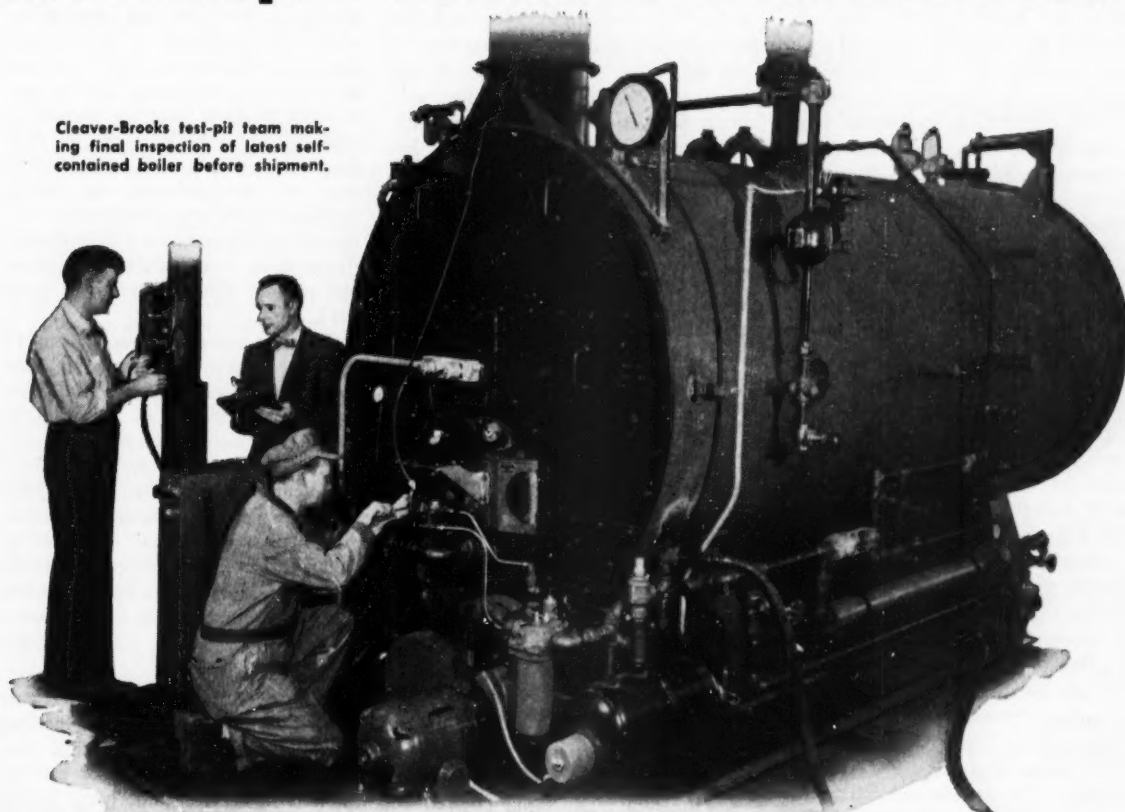


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Cleaver-Brooks test-pit team making final inspection of latest self-contained boiler before shipment.



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A record of this test is available to every buyer on request. In fact, you as a buyer, consultant, or contractor are invited to witness the actual test on your Cleaver-Brooks boiler before shipment.

And further, Cleaver-Brooks boilers are placed in operation at the job site by factory service engineers who check installation, train your operators and make complete and detailed field tests.

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investment. Look to Cleaver-Brooks, the leader in the "Packaged" Boiler field for two decades. Write today for latest Catalog AD-100.

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BOILERS — STEAM OR HOT WATER — FOR HEATING AND PROCESSING IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI

jobber vary. Sometimes you may be given an exclusive territory while in other cases, the same manufacturer may have three or four outlets in the same town. You may or may not have a contract for certain minimum shipments per year. You may prefer those manufacturers whose plants and sales offices are fairly close to your city. Most of the large companies furnish sales assistance in varying forms, customer leads, technical service and help in other ways. Occasionally the larger company may have a contact with a potential customer at another point which would not be available to the jobber.

The question of how much to charge is always difficult. In a given market we know that there will tend to be a single price, governed by supply and demand. This is the price at which just enough people can stay in business to satisfy the demand. This applies to chemical jobbing, too. In any community there is a current price for a given chemical and each local dealer must meet that price or not sell his goods.

The jobber who cuts prices will usually find that he has hurt his own business more than that of his competition. It is, of course, illegal for a group of jobbers to agree on a price for any chemical. Tied up with the question of prices are such matters as discounts for cash payments, carboy and drum deposits, and breakage charges. The jobber must treat each customer the same in these matters or they will surely one day find him out. It is quite customary and ethical to charge more for small lots. That is to say the unit price for twenty carboys of nitric acid is less than if only three carboys have to be delivered.

You'll Be Selling Service

Jobbing chemicals is a service business. In most instances there will be a competitor who has a line of caustic soda which is just about as good as your caustic soda and is probably offered at about the same price. The only thing left for the consumer to decide then is which of the jobbers can be depended upon to deliver the caustic soda at the place specified at the right time. Once a customer-vendor relationship has been established, it is not an easy matter to break. For one thing, the customer has the empty carboys or drums of the jobber on his floor or dock. It is much

easier to re-order and let the jobber take back the empties when he brings a fresh supply than it is to switch to a new supplier.

Also, if the jobber is smart he will have learned exactly what chemicals his customer buys, in what size packages, in what grade, and how often, and will be ready to load his truck the next time he is called. In this way he can take some of the worries off the purchasing agent, who in turn, naturally finds it easier to go along with the same old jobber who knows his requirements so well.

The chemist or engineer in the jobbing business should try to establish contacts with the technical people in the customer's plant, since they will speak his language far more than the purchasing agent, who is probably non-technical. The purchasing agent will be influenced by their recommendations in placing his orders.

Chemical sales are unpredictable at times. The jobber may approach the multi-million dollar plant with high hopes only to learn that its purchasing consists of carloads and bargeloads only. But he should not be discouraged because around the corner may be the little plating shop which uses a hundred carboys a month.

EDUCATION

... Engineering Course on TV

This fall, engineering entered the field of adult education via television. The University of Michigan, College of Engineering will present the telecourse, "Engineering: Building the Modern World," as produced by University of Michigan Television. The course made its debut on WWJ-TV Detroit, on Sunday, Oct. 18, 1953.

Six leading engineering professors will teach the 15 lessons, each lesson continuing for a half hour period on the University of Michigan Television Hour. The aim of the course is to present information about a field vital to our national security and development in a manner that will be understandable to the layman. "Engineering has played a dynamic part in the development of our society," states Prof. Garnet R. Garrison, director of University of Michigan television, "but too few of us understand its fundamental principles and modern applications. Therefore, this course should be of great interest to all."

"Engineering: Building the Modern World" is being coordinated by Robert R. White, professor of chemical and metallurgical engineering. Dr. White specifies that "the record of man's progress toward 'Life, Liberty and the Pursuit of Happiness' is written in the ledgers of engineering. Engineering is the art and science by which the properties of matter and the source of power in nature are used in structures, machines, and manufactured products, and we propose to show in the telecourse exactly how this is done. We are going to focus most of our attention on fundamentals and show problems that come up when we have to use fundamentals. Engineering is always a mixture of art and science plus intuition and guess work."

The telecourse is grouped into 15 lessons covering a full semester. Lesson content will include: the principles of flight and of streamlining; automatic controls such as the thermostat; vacuum tubes and transistors; petroleum refining; chemical processing; the diesel and internal combustion engines; nuclear engineering; metal castings; the strength of metals; and food preservation by irradiation. Course instructors are faculty members of the University College of Engineering.

Course content is primarily concerned with contemporary engineering accomplishments, with special emphasis on graphic illustration and explanation of the underlying chemical and physical principles. The engineering laboratories have been working far in advance of on-the-air time, preparing props for the course presentation. The instructors prepare each lesson with the viewer in mind, remembering that many television viewers have not had a college education. Wide use will be made of live demonstration, film and many other visual aids.

For those who are interested in a more thorough understanding of the course, the university for a fee of \$2 is providing supplementary material in advance of each lesson. This material is prepared by the professor instructing the lesson. With the supplements, and with the knowledge gained through watching the course over television, Michigan families will have the chance to gain a workable understanding of the fundamental importance and applications of engineering.

—End

U.S.I. CHEMICAL NEWS

★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★

Lack of Methionine Causes Hardening of Arteries

In work recently completed at a leading medical school, atherosclerosis, or hardening of the arteries, was produced in *Cebus* monkeys weighing between 1 and 2 kilograms by feeding diets high in cholesterol and low in methionine over periods of 18 to 30 weeks. Within two to eight weeks this diet caused hypercholesterolemia, or high blood cholesterol level, with consequent atherosclerosis and lesions in the ascending aorta and other heart arteries. This condition was also dependent on adequate choline being furnished by the diet. Since both choline and methionine are biological methylating agents, this indicates that sulfur amino acids are directly involved in preventing high blood cholesterol levels rather than methyl-group donors.

It was found that the hypercholesterolemia could be largely prevented by feeding 1 gram per day of DL-methionine as a supplement to the diet. According to the report, once the hypercholesterolemia had been created by the diet, blood cholesterol level could be restored to normal by feeding 1 gram of methionine daily.

Small X-ray Source Offers More Versatility

A small, self-contained source of X-rays for use in industry and medicine has been announced as a likely commercial reality in the near future. The new X-ray source can be made in almost any size, from pellets to larger blocks or sheets, and is said to be entirely self-contained. It consists of a small quantity of radioactive material surrounded by a layer of heavy metal and is claimed to have the advantage of requiring no cumbersome equipment or wiring connections. The radiation emitted is essentially the same as that emitted by X-ray tubes but is reported to be of lower intensity.

Industry will probably use this easier-to-move X-ray source to expand X-ray inspection of vital parts which are difficult or impossible to X-ray with existing equipment. For medicine, the device is said to be potentially more flexible than the radium and radon now used in treating cancer and could conceivably be a valuable supplement to existing techniques.

Hydrazine Used to Remove Free Chlorine from HCl

Hydrazine, a strong reducing agent, has been used to remove free chlorine in the manufacture of chemically pure hydrochloric acid, according to a recent report. The hydrazine combines with the free chlorine to form hydrochloric acid and nitrogen, giving a chlorine-free acid. The amount of chlorine removed is reported to approximate 50 p.p.m. Convenience and economy are said to be the new method's advantages over additional scrubbing or the use of antichlor.

National Petro-Chemicals' New Synthetic Alcohol Plant Now in Production

Produces Industrial Chemicals and Petroleum Products

Production is now well underway at the new \$45 million National Petro-Chemicals Corporation plant at Tuscola, Illinois. Built primarily to produce synthetic ethyl alcohol, the plant will produce about 125,000 gallons a day.

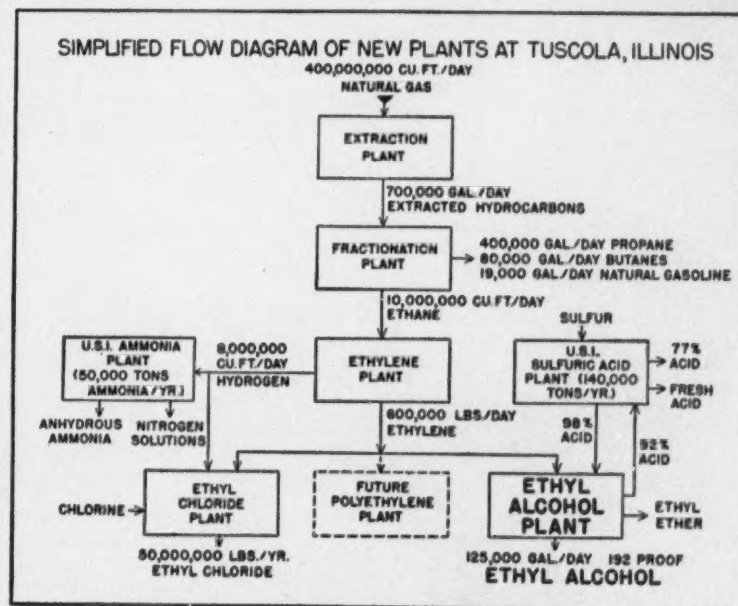
As the flow diagram shows, alcohol is produced from ethylene, which is obtained from the "cracking" of ethane. The ethane in turn is obtained by fractionating hydrocarbons extracted from the starting material: natural gas. The ethylene unit is the largest of its kind, cracking 10 million cubic feet of ethane a day into ethylene and hydrogen.

U.S.I. Plants on Site

To make use of the by-product hydrogen from the ethylene unit, U.S.I. is building a \$7 million ammonia plant at Tuscola which is scheduled to start production in October, 1954. The plant is expected to produce 50,000 tons of ammonia per year. Some of this will be sold as anhydrous ammonia for industrial and agricultural use, but the bulk will be converted to nitric acid, from which ammonium nitrate will be produced and used for the making of nitrogen solutions. The nitrogen solutions will be sold to fertilizer manufacturers.

In the conversion of ethylene

MORE



For detailed information, write for 40-page booklet "From Cornfields to Chemicals."

U.S.I. CHEMICAL NEWS

CONTINUED

New Synthetic Alcohol Plant

to alcohol, large quantities of sulfuric acid are needed. To fill this requirement, U.S.I. built a \$2 million sulfuric acid plant alongside the National Petro-Chemicals facilities. After the acid is used in the alcohol unit, it is partly reconcentrated and is returned to U.S.I. for further fortification and for sale, principally to fertilizer manufacturers. Acid production is 140,000 tons per year.

Not all of the ethylene produced from cracking ethane will be used for alcohol manufacture. Some will serve as raw material for the production of 50 million pounds of ethyl chloride a year. This organic chemical is a basic raw material for the manufacture of tetraethyl lead for high octane gas. Other by-products of the overall process are propane, butanes, and natural gasoline (from the fractionation plant) and ethyl ether (from the alcohol plant).

Further expansion is planned for 1955, when a polyethylene plant is to be completed. Initial output is expected to be about 25 million pounds a year, with additional expansion the following two or three years.

Propane Underground

An unusual feature of the hydrocarbon plant is the storage of 6.3 million gallons of propane underground in limestone caverns—at a capital expenditure only one-third that of surface storage. A tunnel 400 feet long and 330 feet under the earth's surface was drilled, and at right angles to the tunnel, five parallel 450-foot horizontal shafts were mined. These storage facilities are believed to be the second largest of their kind in the world.

National Distillers Products Corporation, of which U.S.I. is a division, manages and operates the National Petro-Chemicals Corporation plant. The new corporation is owned 60% by National Distillers and 40% by the Panhandle Eastern Pipeline Company.

New Booklet on Methionine For Supplementing Feeds

A round-up of current information on methionine as a poultry, swine, dog and mink feed supplement has been published and is available from U.S.I. on request. Entitled "What Methionine Can Do for You", it is a compilation of articles by leading research and technical specialists. Methionine's value as a feed supplement, possible new uses for methionine, and pointers for feed manufacturers on how to supplement their feeds with methionine are among the subjects discussed by the various authors. A pioneer producer of DL-methionine, U.S.I. has stocks located strategically throughout the U.S.A. for the convenience of the feed trade.

Magnesium Possible Fuel For Engines of Future

Magnesium-fueled engines are a possibility when petroleum supplies are exhausted. Powdered magnesium, 2 to 6 microns in diameter, could be an important fuel of the future, according to an authority in the field. Some 300 pounds of powdered magnesium can develop horsepower equivalent to 3,000 gallons of aviation gasoline. Although changes in engine design would be necessary, they would result in fewer working parts.

Reports on New Lubricants

Two research reports reviewing characteristics of new lubricating materials are now available. One describes how turpentine, combined with other ingredients, can be made to form synthetic lubricants, oils and greases for use in low-temperature areas. The second research report is on the frictional behavior of polyethylene, polytetrafluoroethylene, and halogenated derivatives.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

A coloring material compatible with all types of paint products—oil, rubber, alkyl, or varnish based—reportedly has been developed. Eighteen light shades are offered, with darker tones being added to the line. (No. 1000)

To measure specific gravity of flowing material without contact, a system has been devised where nothing but radiation enters the pipe. It is described as useful with flowables of specific gravities from 0.5 to 2.75. (No. 1001)

For quantitative analysis of several metals from the same solution, a controlled-potential electro-analyzer is being introduced. It should speed up routine analyses of alloys and other samples with more than one metal and should be useful to researchers. (No. 1002)

A new cooling tower with fewer construction parts is claimed to simplify erection and maintenance and to give better performance through a bracing system that provides minimum obstruction to the free flow of air. (No. 1003)

A flexible tubing resistant to most inorganic acids and alkalis and many organics is available with inside diameters ranging from 0.12" to 1". It is described as ideal for any temporary or permanent fluid lines where easy-to-handle, sturdy tubing is needed. (No. 1004)

A filter for fuming nitric acid and other corrosives has been announced. Industrial tests indicate that the new filter medium is completely resistant to all common acids and gases. (No. 1005)

A new gasoline additive which is said to prevent preignition and spark plug fouling was recently announced. The knocking which results from preignition reportedly is reduced. (No. 1006)

An alkali-resistant, synthetic filter aid offering porosity and combustibility is being introduced. The new product is a free flowing grade of carbon that is said to provide the same porosity and permeability offered by diatomaceous earth. (No. 1007)

Ordinary cotton cloth won't flame at 4500°F. after treatment with an agent which retains its resistance even after repeated laundering, it is reported. Besides industrial use, the specialty shows promise for draperies, mattress covers and other home furnishings. (No. 1008)

A new diuretic is said to offer health gains for patients suffering from edema resulting from congestive heart failure. A nonmercurial compound unrelated to any existing diuretics, it is administered orally. (No. 1009)

PRODUCTS OF U.S.I.

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Amyl Alcohol (Isoamyl Alcohol)
Butanol (Normal-Butyl Alcohol)
Fusel Oil—Refined
Prepanol (Normal-Propyl Alcohol)

Ethanol (Ethyl Alcohol)

Specialty Denatured—all regular and anhydrous formulas
Completely Denatured—all regular and anhydrous formulas
Pure—190 proof U.S.P., Absolute—200 Proof
Solox—proprietary solvent—regular and anhydrous

ANTI-FREEZE

Super Pyre® Anti-Freeze
U.S.I. Permanent Anti-Freeze

ETHERS

Ethyl Ether, U.S.P.
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ACETONE—A.C.S.

ANISOLS

Anisol® M
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ACETIC ESTERS

Amyl Acetate—Commercial and High Test
Butyl Acetate
Ethyl Acetate—all grades
Normal-Propyl Acetate

OXALIC ESTERS

Dibutyl Oxalate
Diethyl Oxalate

PHTHALIC ESTERS

Diamyl Phthalate
Dibutyl Phthalate
Diethyl Phthalate

OTHER ESTERS

Diethyl Carbonate
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RESINS (Synthetic and Natural)

Arochem®—modified types
Arodure®—urea-formaldehyde resins
Aroflex®—pure phenolics
Aroflat®—for special flat finishes
Aroflint®—room temperature curing phenolic
Aroplex®—alkyls and allied materials
Aropol®—copolymer modified alkyls
Ester Gums—all types
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INSECTICIDE MATERIALS

Allerthrin
CPR Concentrates: Liquid & Dust
Piperonyl Butoxide
Piperonyl Cyclonene
Pyrene® Concentrates: Liquid & Dust
Pyrethrum Products: Liquid and Dust
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INSECTIFUGE MATERIALS

Indalone®
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INTERMEDIATES

Acetoacetanilide
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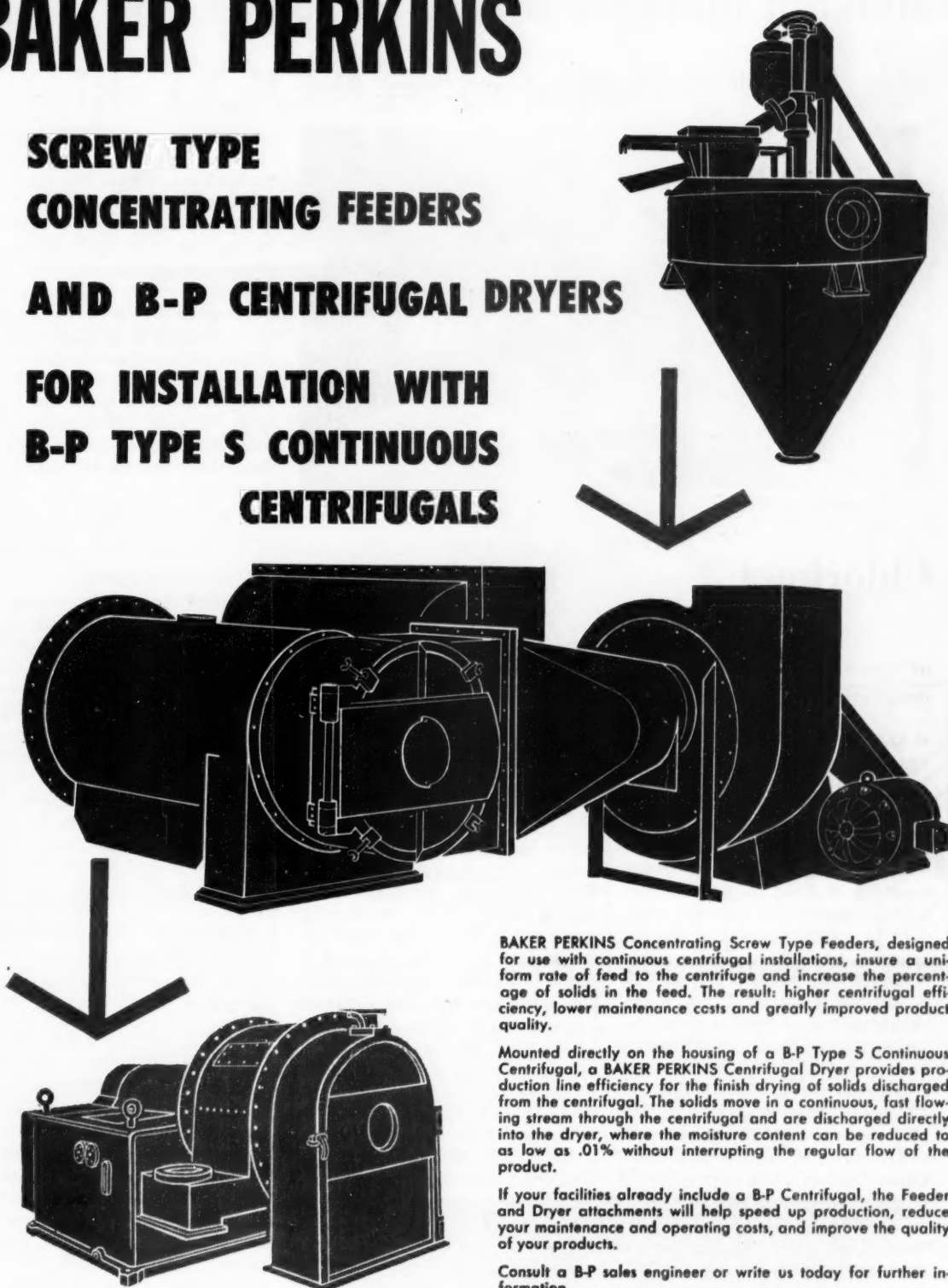
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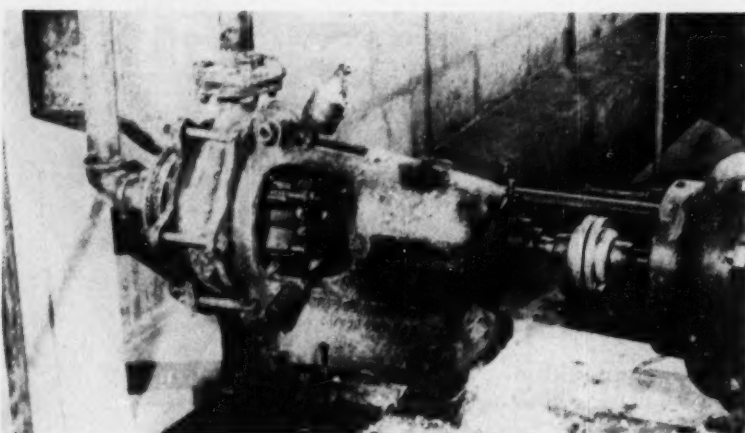
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Chlorimet 2

The corrosion resistance of this important material of construction to a number of corrosives, with physical properties and applications in the chemical industry.

WALTER A. LUCE

The Durlon Co., Inc., Dayton, Ohio

Chlorimet 2 is a high alloy material designed to give high strength and excellent corrosion resistance under severe corrosive conditions. It consists essentially of nickel and molybdenum, a combination which provides resistance to specific corrosive media not approached by other types of commercially available metals or alloys. This is particularly true with hot hydrochloric acid of all concentrations and various strong chlorides providing they have no strongly oxidizing tendencies.

Nominal chemical composition of Chlorimet 2 is given in Table I. The alloy consists essentially of two parts nickel to one part molybdenum. Other elements which serve no useful purpose and even appear deleterious are maintained at a practicable minimum. Iron is the most important of these elements, and it is maintained at 3 percent maximum. The useful mechanical and physical properties of Chlorimet 2 are given in Table II.

Chlorimet 2 is available in the cast form only. Although it is primarily fabricated into such equipment as pumps and valves, it is also available

as special castings. Maximum corrosion resistance is obtained by uniformly heating all castings to approximately 2,050 deg. F. followed by water quenching. All Chlorimet 2 castings are given this treatment to assure best service. Higher heat treatment temperatures were found to be of no benefit when the chemical composition was closely controlled within the limits given in Table I. Although Chlorimet 2 can be hardenable by long-time heating at an intermediate temperature (1,290 deg. F.), this procedure is only occasionally used because some of the corrosion resistance is sacrificed by this treatment. However, under conditions where wear and

abrasion resistance are needed and the corrosion resistance is still adequate, the hardened alloy has found some application.

The machinability of Chlorimet 2 castings can only be considered fair when comparison is made with other machinable alloys. It is an extremely tough alloy but with proper technique and equipment it can be machined. It is suggested that carbide grade cutting tools be used. A rigid set-up is necessary to overcome chattering. A slow surface speed and a relatively deep feed provide best results. Chlorimet 2 work hardens readily and for this reason light cuts during machining should be avoided. Chlorimet 2 is readily weldable with the metallic-arc method recommended to avoid carbon pick-up.

As mentioned in the opening paragraph, Chlorimet 2 is mainly applied for those severe services where other less expensive alloys will not suffice. Because it contains no chromium, this alloy must be used only in reducing or neutral media. Hydrochloric acid is the most commonly encountered reducing acid which cannot be handled by the more conventional alloys and it is for this acid that Chlorimet 2 is usually applied. Except for the noble metals, all metals and alloys have limited application in hydrochloric acid. Most commercial alloys are limited to very dilute solutions at low temperatures and only the high-silicon iron alloy, Durichlor, is extensively used under more severe conditions. However in most cases this latter alloy will not handle the hot, strong acid. In addition, it has limited mechanical properties. Chlorimet 2 shows very good resistance to all concentrations of hydrochloric acid to the respective boiling points. If oxidizing contaminants are essentially absent, there is no restriction on its use below the boiling point. Limited corrosion data also indicate that this good resistance actually extends above the normal boiling points for many concentrations but the high temperature limits have not been clearly set.

In practice, Chlorimet 2 equipment has been successfully applied for hydrochloric acid services under a wide

(Continued on page 252)

Table I—Nominal Chemical Composition

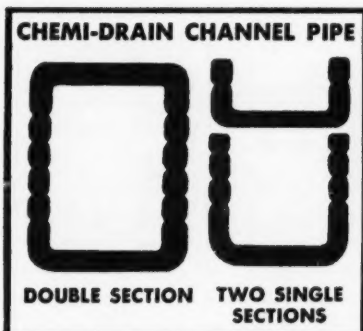
Nickel	62.00
Molybdenum	32.00
Iron	3.00 max.
Silicon	1.00
Carbon	0.10

Table II—Physical and Mechanical Properties

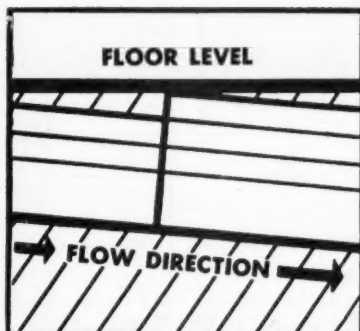
Tensile strength, psi.....	80,000
Yield strength, psi.....	55,000
Elongation, %.....	6
Hardness, Brinell	230

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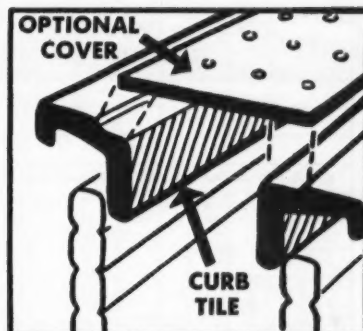
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- By installing sections of Chemi-Drain of progressively increasing depths, you get a sloping drainage line that has excellent flow characteristics and freedom from accumulation of sediment.



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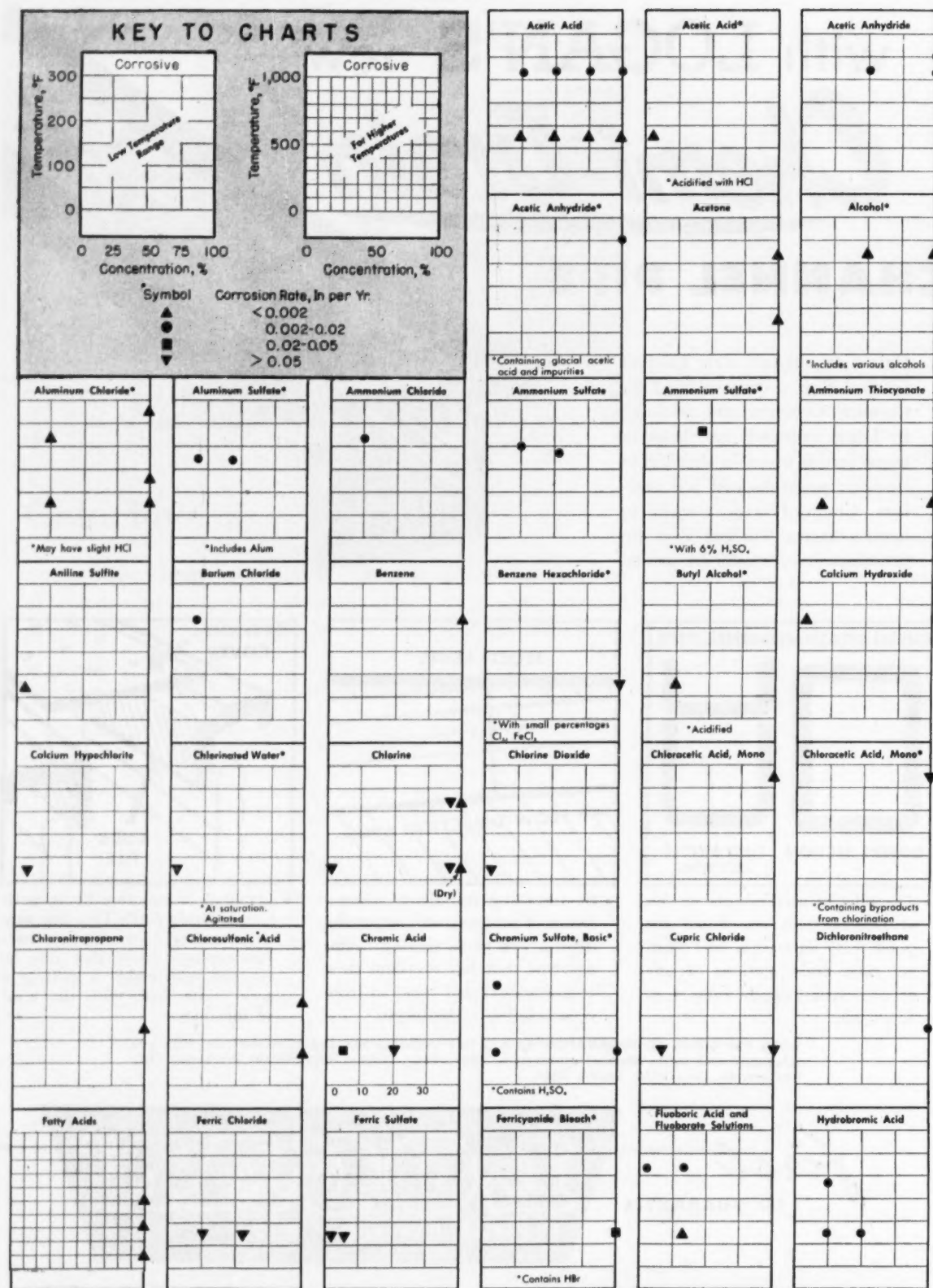
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Corrosion Resistance of Chlorimet 2



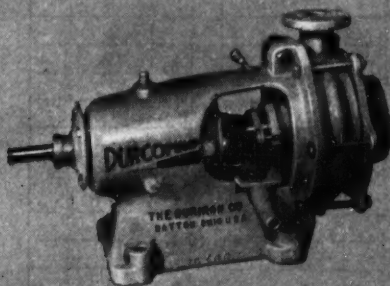
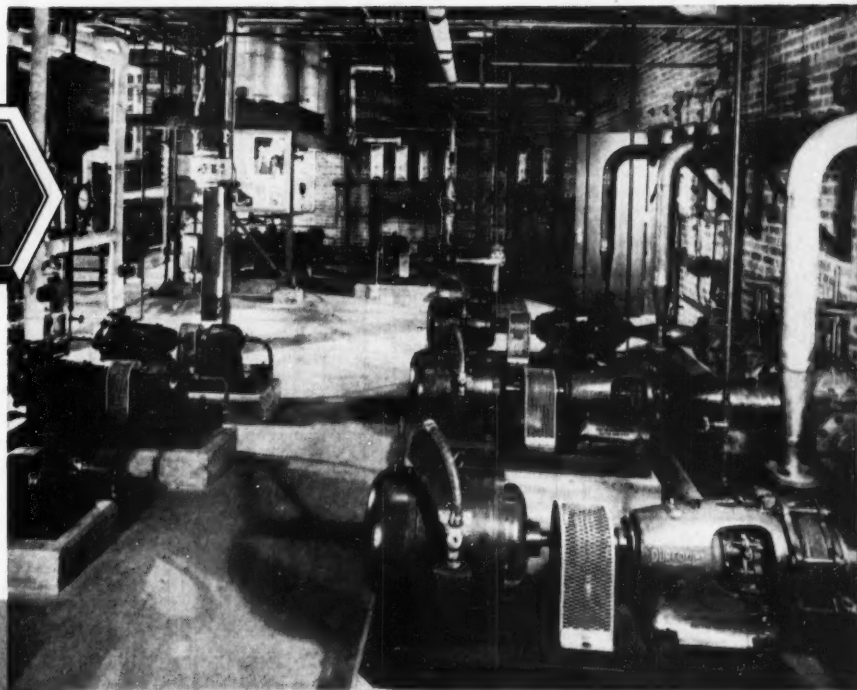
(Continued on page 250)

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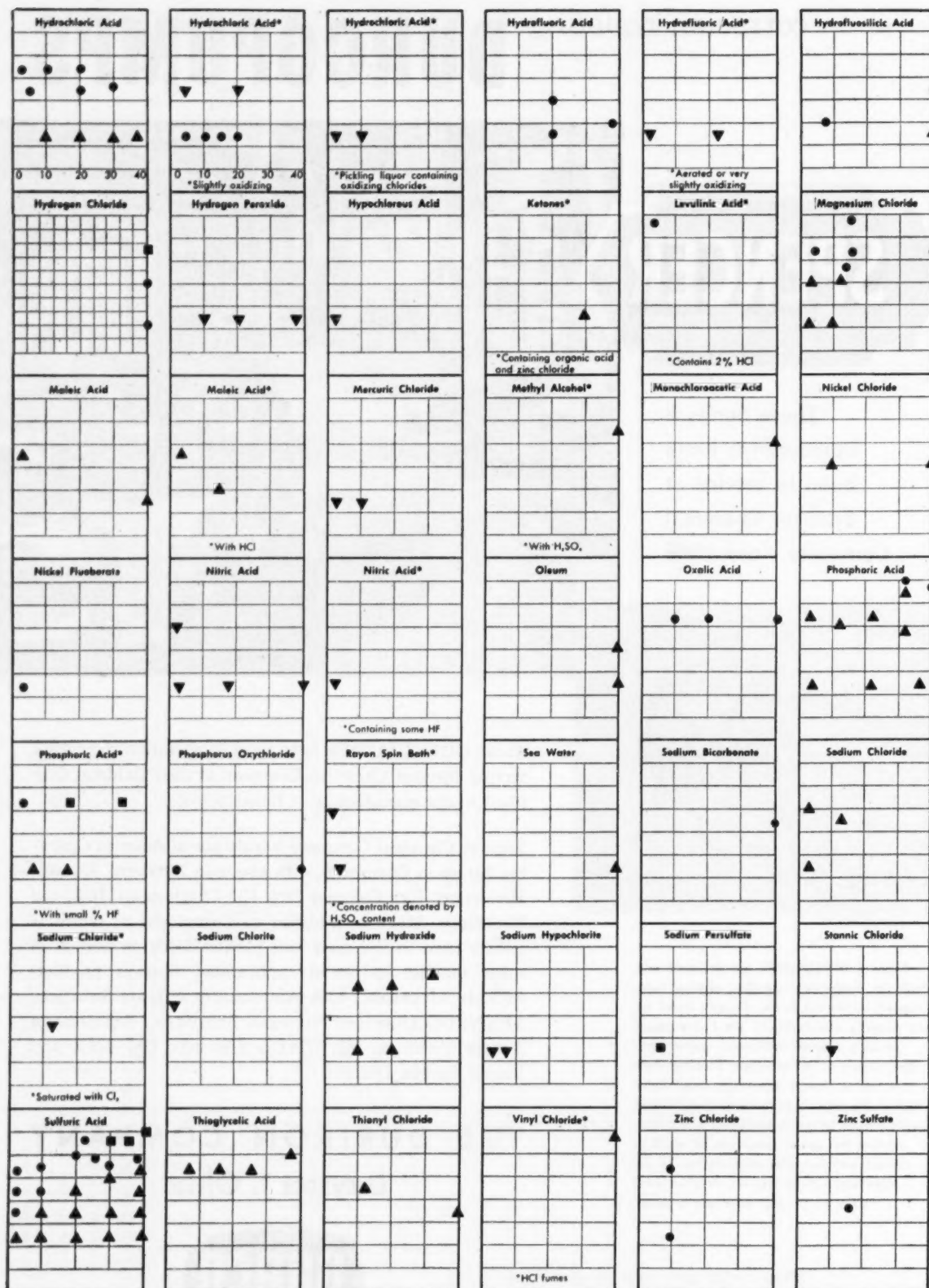
Spencer Chemical Company is truly one of America's growing names in Chemistry, with plants in Pittsburg, Kansas; Henderson, Ky., Calumet City, Ill.; Charlestown, Ind., and Vicksburg, Miss. In addition to formaldehyde, which is widely used in the resin and plastics fields as well as in other familiar industrial applications, Spencer products include Methanol, 83% Ammonium Nitrate Solution, SPENSOL (Spencer Nitrogen Solutions) Ammonium Nitrate Fertilizer, FREZALL (Spencer Dry Ice), and Liquid Carbon Dioxide.

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Corrosion Resistance of Chlorimet 2, cont. . . .



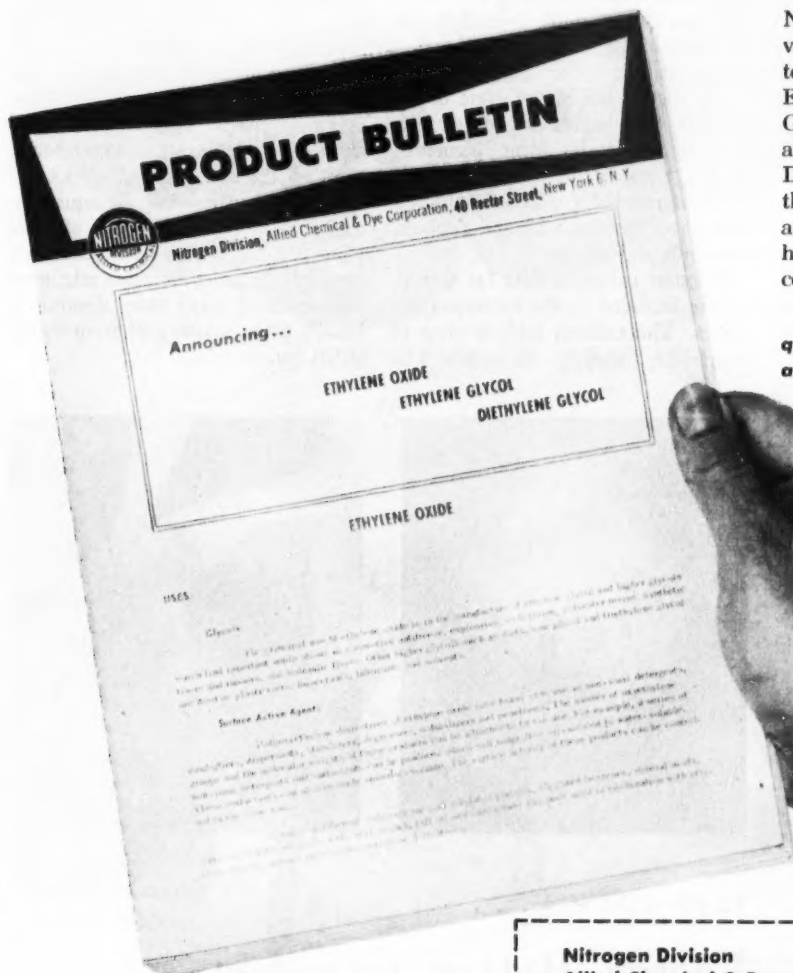
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variety of conditions. All concentrations from very dilute to concentrated have been handled from ambient temperatures to elevated temperatures. In most cases, however, hydrochloric acid is only one of several chemicals encountered in a particular corrosive solution. Many destructive chlorides are handled in the presence of this acid which only increases the severity of the handling problem. Hydrochloric acid is also handled with other acids or with various organic chemicals either alternately or in combination. Normally if Chlorimet 2 is resistant to the various chemicals separately it will successfully handle them in combination. The picture illustrates a typical application for Chlorimet 2. This pump is used for a combination of streptomycin and hydrochloric acid in the production of that pharmaceutical. No contamination could possibly result from this alloy.

Chlorimet 2 finds application for other severe services such as strong, hot sulfuric acid, strong phosphoric acid, various destructive chloride solutions, and other similar services. This type alloy is the only one other than the high silicon irons which will handle 70 percent—90 percent sulfuric acid at temperatures between 175 and 225 deg. F. It will also show low corrosion rates in boiling sulfuric acid from 10 percent to 60 percent. It also shows very low corrosion rates to most hot, strong phosphoric acid services. Chlorimet 2 equipment has been successfully applied for such chlorides as magnesium chloride, aluminum chloride, phosphorus oxychloride, phosphorus trichloride and others. Good resistance is exhibited even under acid conditions. It must be emphasized that the presence of cupric, ferric, or other highly oxidizing metallic ions will materially alter the corrosion resistance of Chlorimet 2. If only minute quantities of these ions are present or are suspected, a plant test will quickly indicate the expected resistance.

The toughness of this alloy, which limits its machining characteristics, renders this alloy resistant to many severe erosion-corrosion services. In one application Chlorimet 2 pumps were found to be an economical substitute for Duriron pumps (Brinell hardness 520) despite the much greater initial cost for the Chlorimet. The service involved a very heavy

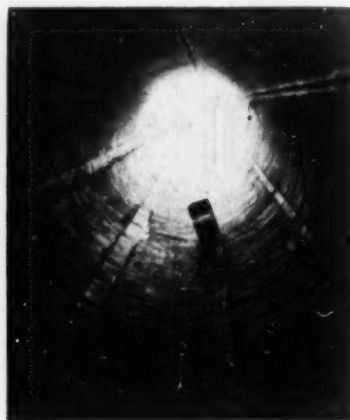
slurry which was strongly acid. Previous testing indicated that Duriron was the only composition of the numerous ones tested exhibiting an economical service life, but additional work with Chlorimet 2 proved it to be even better. This is only one of the many slurry services where Chlorimet 2 is applied.

The industries utilizing Chlorimet 2 equipment are quite diversified and include most of those in which hydrochloric acid is encountered. It finds application in the manufacture of detergents, insecticides and other agricultural chemicals, paint pigments, plastics, pharmaceuticals, synthetic fiber intermediates, solvents, chlorinated waxes, organic acids and alcohols, dye stuffs and others.

Practical corrosion data for this alloy are included in the accompanying charts. These charts include most of the severe chemicals for which it is

currently finding application and also include many of those common corrosives for which it is unsuitable. The numerous organic chemicals for which Chlorimet 2 would be completely resistant have been omitted because this information would serve no useful purpose. Chlorimet 2 will handle those chemicals except if strongly oxidizing, and as stated above, the resistance to mineral acids will not be affected by these organic compounds.

It is recognizably difficult to adequately transpose plant data to these corrosion charts. Not only is it difficult to cite the exact corrosive conditions on these charts, but service life is hard to transpose into an actual corrosion rate. In the absence of prior plant test data which would definitely establish the exact corrosion rate, good service life of many years' duration is usually given a rating of from 0.002-0.020 ipy.



LEAD LININGS . . .

Faster, Better, Cheaper

New stud driver eliminates drilling of strap and shell as well as the set-up operation, resulting in a time saving of 70 percent. Erection costs down 60 percent.

A new method for fastening strapped lead linings has been perfected and field tested. It substantially cuts cost and in other ways makes a strapped lead lining more desirable.

While the use of bonded lead linings or lead claddings has, in many cases, replaced the strapped sheet type of lead lining in chemical construc-

tion because a cladding more effectively combines the working strength of steel with the superior corrosion resistance of lead; nevertheless, there are many applications where the extra expense of a bonded lead lining is not warranted and where a strapped lining will do the job just as efficiently. For this reason strapped lead linings



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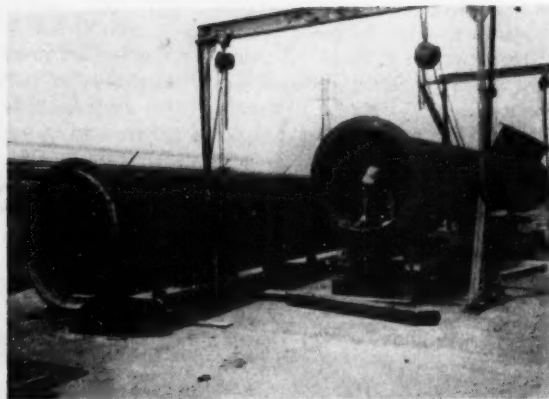
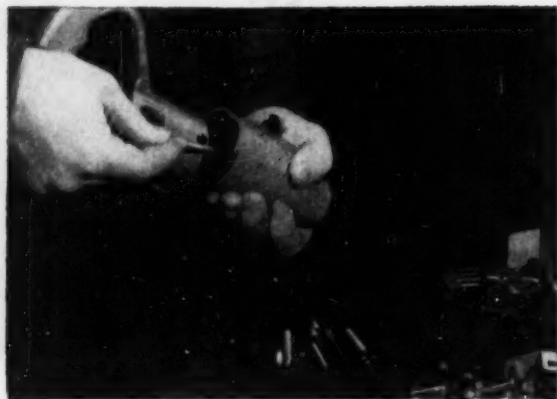
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are still recognized as an important method of utilizing lead for handling corrosive liquids or fumes and any developments making such installations easier or more economical are especially significant.

Latest of such developments is a method that makes use of a cartridge powered tool or "stud driver." It is used for securely anchoring steel straps to a lead lined steel vessel without drilling and matching bolt holes or for fastening sheet lead to concrete without requiring the time-consuming and expensive method of sinking anchor bolts. It has also been used with marked success and great cost savings in X-ray room lining operations for fastening sheet lead to cinder block walls and then covering the heads with small patches of sheet lead to form a radiation-proof shield. If desirable, wood studding can be anchored to concrete, steel or cinder block with the stud driver. The sheet lead is then anchored to the studding.

Pioneering in the application of the cartridge powered stud driver, the Remington Arms Co., in cooperation with the Lead Industries Assn., arranged with a number of lead fabricators to test the new device under actual service conditions. Equipment erected with the aid of the stud driver now having been in service for two years, the results of the program indicate that the tool is a pronounced success.

In general, the cost reductions involved over customary fastening techniques have been about 60 percent; a saving largely the result of lowered labor costs. For example, the Lone Star Lead Construction Co. in Houston, Tex., installed a lead lining in a 35 ft. tank without having to erect

scaffolding on the outside, an expensive and time-consuming operation. With the stud driver all the work was done from the inside in less than half the time normally involved. On one job, Knapp Mills, Inc., Long Island City, N. Y., estimated 500 hr. for drilling and bolting of straps but by using the stud driver they were able to reduce this time to only 150 hr.

Soon to receive its first field trial is a unique stud driver application perfected by the New England Lead Burning Co. of St. Louis, Mo. Wherever the lead lining in a steel vessel is to be strapped, a strip of 16-lb. lead, 5 in. wide is first laid down on the lead lining. On this is centered a steel strap 2 in. wide and $\frac{1}{8}$ in. thick. The whole "sandwich" is flattened at the point of fastening and a stud driven every 4 ft. on center. The lead strip is then turned up over the steel strap and joined by welding thus sealing the steel away from contact with corrosives. This method not only is considerably faster than the conventional method of covering straps but cuts the number of lead welded seams, and thus the cost of lead welding, in half.

The maximum thickness of strapped lead lining thus far successfully fastened with the stud driver is through $\frac{1}{4}$ in. steel strap, plus $\frac{1}{4}$ in. lead lining, plus $\frac{1}{4}$ in. steel shell. There is evidence that the thickness of the lead is more or less inconsequential inasmuch as it behaves more as a lubricant for the steel stud rather than as an impediment.

Operation of the stud driver is extremely simple and safe and does not require a skilled operator. The illustrations show how the tool was used on a typical lead lining job. After selecting the proper stud for the job

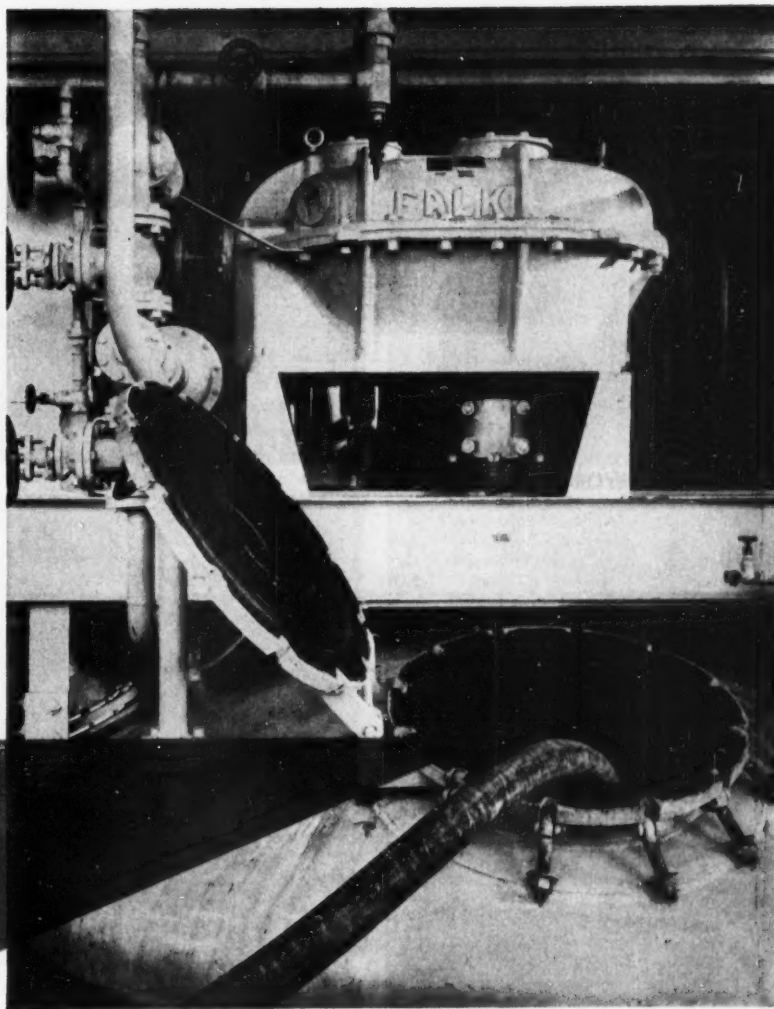
(simple nail-type, break-off head type, or threaded—all in various lengths) and inserting it in the end of the cartridge (six different cartridges are available depending upon power or driving force required), the assembled stud and cartridge is then inserted in the chamber of the portable driver. The tool is pressed in position against the steel strap, safety lever depressed, and the trigger pulled, leaving the strap firmly secured to the steel shell with the lead lining held tightly in between. Tests on the strength of the stud have shown that the normal nail-type stud will continue to hold, long after a $\frac{1}{4}$ in. mild steel nut and bolt would have failed by shearing.

The studs as now produced by Remington are hardened steel with a Rockwell C of 51 to 55. They obviously are not recommended for penetrating cast iron or specially hardened steel.

In a typical strapped sheet lead lined steel vessel, the use of the stud driver eliminates the drilling of the strap and shell, an operation requiring about 12 min. after marking, and the set-up operation which takes about 2 min. making a total of 14 min. for each hole. Set-up applies to the erection of the necessary staging and equipment so that the operators can have proper leverage for drilling. Stud driving, on the other hand, takes approximately 2 min. per hole for loading the gun and shooting the rivet after the set-up, making a total of only 4 min. per hole, a time saving of more than 70 percent. Furthermore, marking time can be cut down considerably because in driving studs it would not be necessary to adhere to a specific spacing. Studs could be driven virtually at random.

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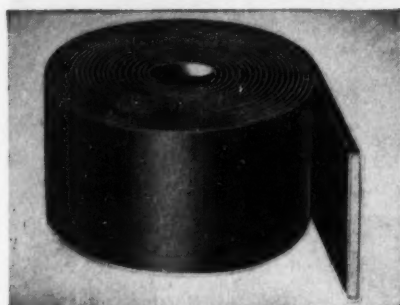
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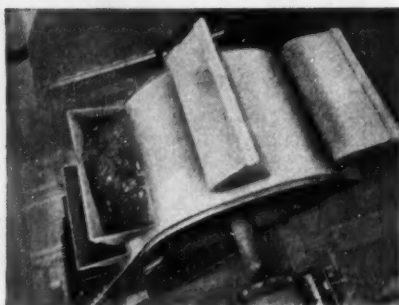
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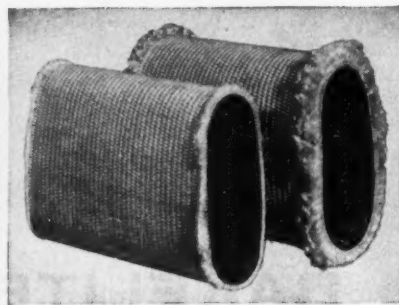
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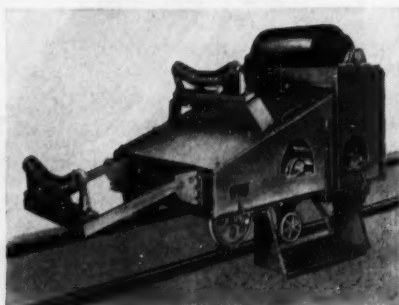
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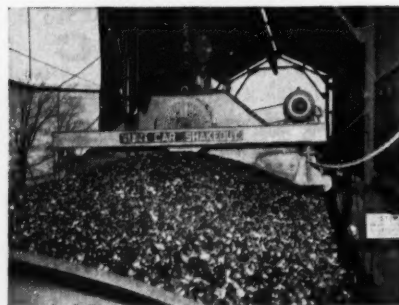
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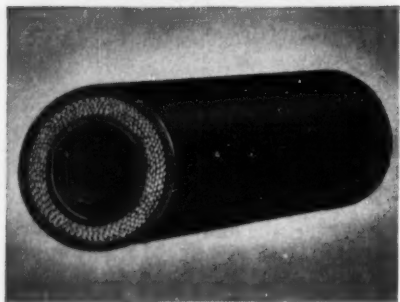
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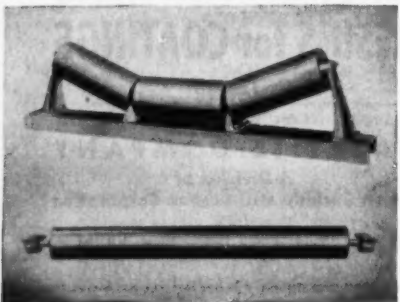
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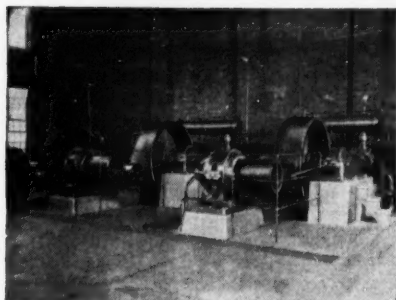
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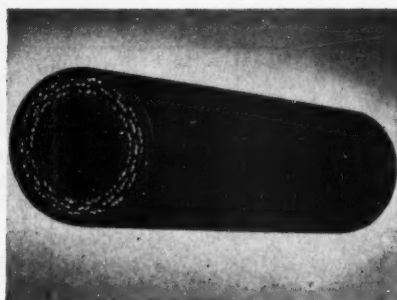


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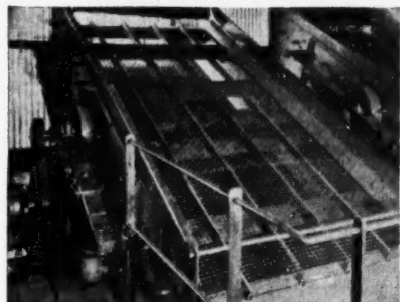
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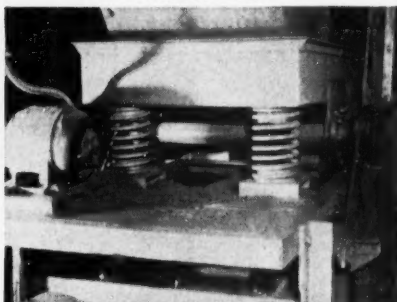
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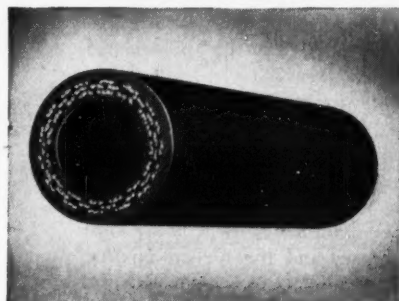
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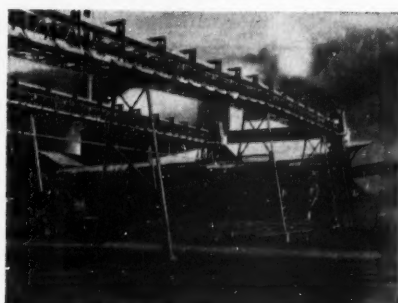
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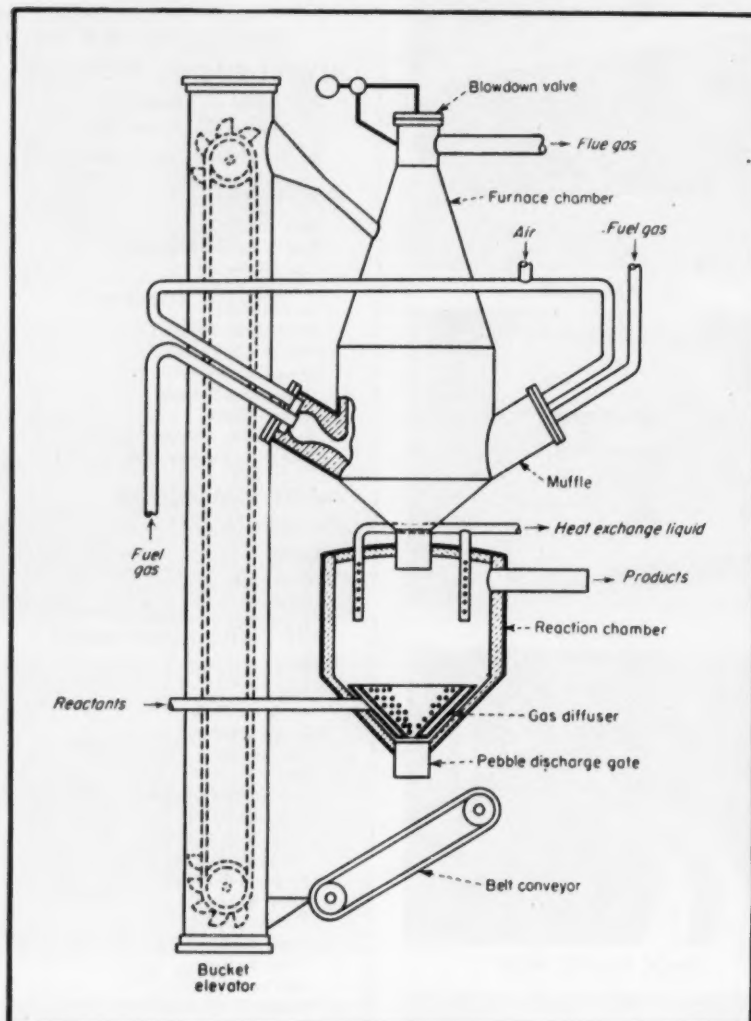
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1885

NEW EQUIPMENT PATENTS



New Pebble Heater Design

Use of radiant heat plus hot combustion products gives this pebble heater an edge over the conventional type when it comes to efficient use of fuel.

Though in wide use as reactors and as gas heaters, conventional pebble heaters are not noted for efficient fuel use. The reason is that they are designed so that the pebbles are heated primarily by contact with hot combustion products. Since ceramics materials are poor thermal conductors, contact with hot gases is insufficient to raise the entire mass to the desired

temperature uniformly, and to make the best use of the heat supplied.

To overcome this deficiency a new heater has been designed which heats the ceramic pebbles not only by the conventional method but by radiant heat at about the flame temperature of the fuel gas as well.

► **The New Design**—As shown, the apparatus consists of three major parts:

the furnace chamber, the reaction chamber and pebble elevator. The furnace is an elongated steel chamber with a refractory lining. Its lower end is tapered and leads into the reaction chamber.

The reaction chamber has a steel or alloy shell and may also have a lining of refractory material. Pebbles flow continuously from the furnace to the reactor and are discharged onto an endless metal belt. The belt delivers the pebbles to the bottom of the bucket elevator which conveys them back up to the top of the furnace and discharges them into that chamber through a chute.

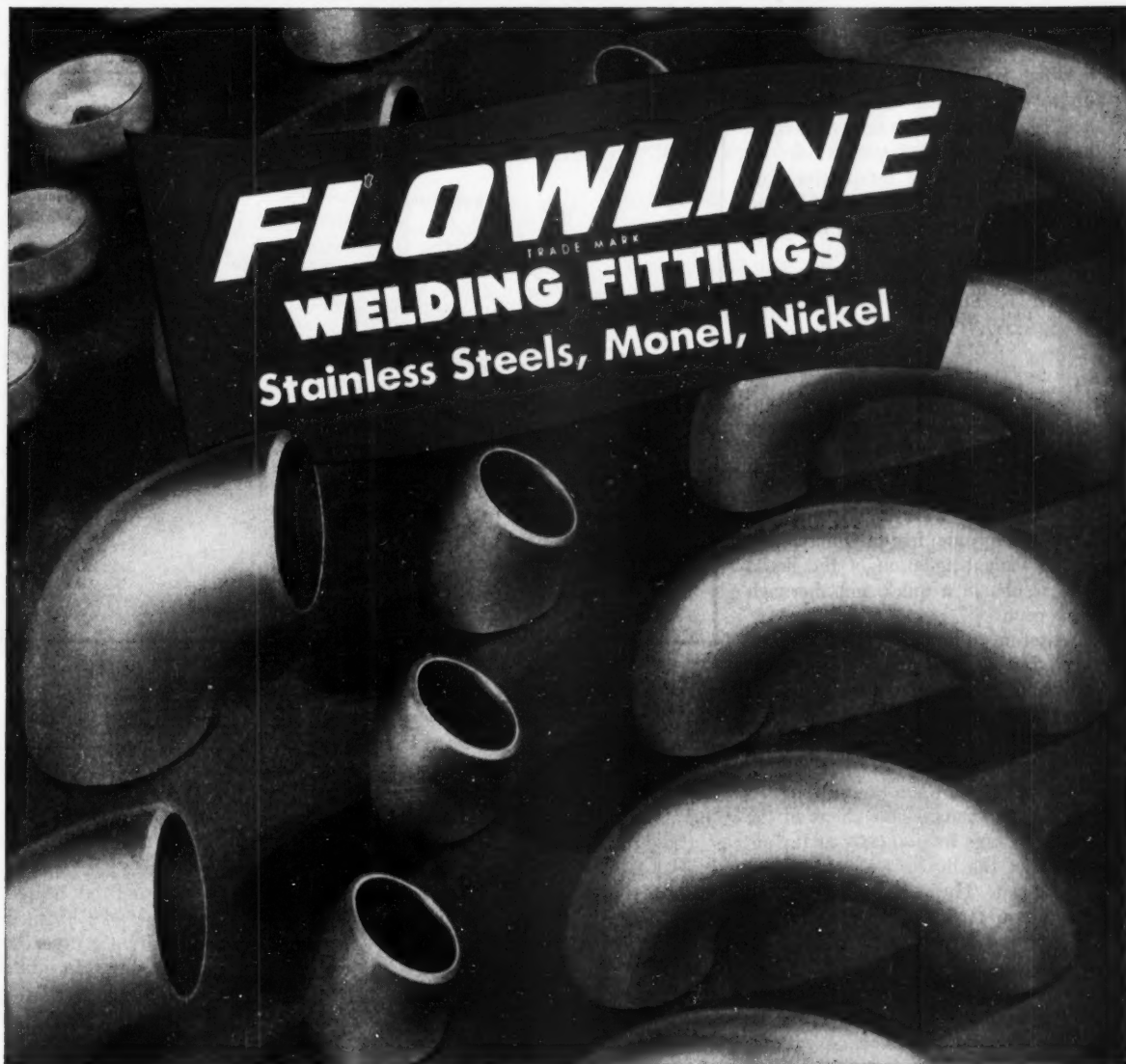
► **How It Works**—Crux of the new design is the method of using radiation to heat the pebbles.

The furnace heating system includes one or more muffles, provided with a pear-shaped chamber, opening into the interior of the furnace. Fuel gas is supplied through the burner. It is mixed with air in the enlarged portion of the pear-shaped muffle chamber.

Fuel and air velocities are kept at or above the limit of flame propagation velocity so that only a small part of the fuel is actually burned in the muffle.

The unburned portion passes into the furnace and the fuel-air mixture is burned directly in contact with the pebbles. Thus heat transfer occurs at approximately flame temperature. Certain refractory substances which catalytically assist combustion may be used as pebbles. Very efficient combustion of the fuel is the result.

Combustion products are appreciably cooled by yielding a large part of their heat to the pebbles through radiation. However, the heated combustion gases transfer additional heat by convection and contact. The rate and efficiency of the heat transfer to the pebbles depends on the velocity of the flowing gases. Therefore, the upper part of the furnace is so formed as to provide a progressively decreasing cross-sectional area. This maintains a relatively uniform gas velocity through the bed of pebbles—despite the progressive decrease in gas volume due to cooling.



FLOWLINE TRADE MARK **WELDING FITTINGS** Stainless Steels, Monel, Nickel

3000 Stock Items Made by Corrosion-Resistant Specialists

The makers of FLOWLINE Welding Fittings were the first to standardize, manufacture, and stock a complete line of welding fittings for corrosion piping. These fittings are handled by leading distributors throughout the country who are experts in corrosion piping problems.

The most economical and efficient corrosion-resistant piping system is obtained by using FLOWLINE Fittings. Any conceivable layout can be constructed with them simply by straight cutting of pipe to desired lengths and plain butt welding. The advantages include minimum initial cost and faster fabri-

cation of a compact, light weight and strong system which is permanently leak-proof and has best flow characteristics.

FLOWLINE Welding Fittings — ells, tees, stub ends, reducers, and caps — are normally stocked at strategic points in Schedules 10, 40, and 80 (Schedule 5 also available) — sizes $\frac{1}{2}$ " through 12" — in stainless types 304, 316, and 347; Monel and Nickel. They are annealed, cleaned bright — stainless fittings are passivated — and marked with type of metal, heat number, size, schedule, and wall thickness.

WELDING FITTINGS CORP.

NEW CASTLE, PENNSYLVANIA

World's Largest Manufacturer of Stainless Welding Fittings

► **What It Does**—It is claimed that up to 65% of the total recoverable heat is obtained in the form of radiant heat, and most of the remainder by convection. Pebble temperatures of 1600 F. can be readily attained by the use of this design, with great economy in the fuel burned.

The new design is the invention of Robert E. Stanton. His patent is U. S. 2,657,917.

How to Emulsify Ultrasonically

One way to make that hard-to-form emulsion is to form the liquid stream into a jet and let it impinge upon a steel spring blade, free to vibrate. This causes violent agitation of the liquid and results in a quick and thorough dispersion.

A set-up to do this job has recently been described. It consists of an electric motor and a rotary pump mounted as a portable unit, together with a device to cause the vibration fitted to the pump delivery pipe.

► **Jet Producer**—The liquid jet is formed by changing the shape of the liquid passage from circular at the entrance of the device to a narrow slit at the exit. The pressure built up by the pump forces the liquid through the slit at a high velocity.

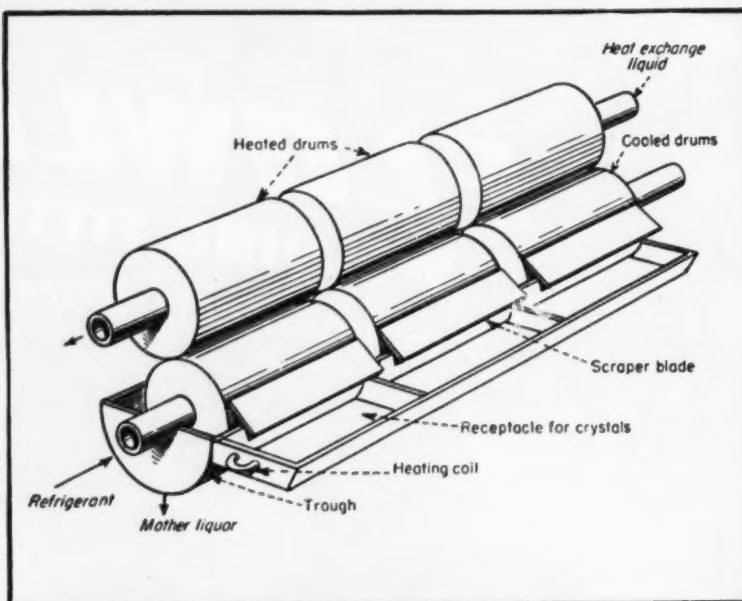
The liquid jet impinges on a blade made of spring steel. The blade is supported at one end and free to vibrate at its own frequency without support at its sharpened edge.

A resonant nose piece is screwed onto the jet-former to surround the blade and its mounting. It has an open circular end whose diameter is approximately equal to the length of the slit outlet of the jet-former. This amplifies the effect of the vibrations.

► **In Operation**—When the device is in use the mixture is sucked into the pump and expelled through the slit at pressures ranging from 130 to 300 psi. The elasticity of the blade sets up ultrasonic vibrations. Cavitation of the blade tip causes violent agitation of the liquid, resulting in emulsification.

It is claimed that the power requirement is only a small fraction of that needed in conventional emulsifiers.

The device was developed by a brace of British inventors, Eric C. Cottrell and John E. Goodman. Their patent is U. S. 2,657,021.



Improves Fractional Crystallization

In the "good old days," when technology was less complex, crystallization was accomplished by either placing a cooling coil in your solution or putting the solution container in an ice bath. When the crystals had formed, you took up your pick or axe and chopped them from the tank sides. From a production-plus-purity standpoint this method belongs to the stone-age of chemical engineering and is rarely used today.

Today there are more than a score of equipment designs to handle all types of crystallization problems. One of the newest of these designs—a multi-stage, fractional crystallizer, featuring improved removal of occluded mother liquor—is shown above.

► **How It Works**—Each of the lower drums is internally cooled by a suitable refrigerant. The cooled drum dips into a trough containing the liquids to be separated and the higher-melting fraction freezes on the drum surface. As the drum rotates, frozen material is pressed by another drum. This squeezing action effectively removes occluded mother liquor from the newly-formed solid phase.

Internally-circulated heat exchange liquid keeps the pressure drum at a temperature higher than that of the cooled drum, but not high enough to melt the crystals formed on the refrigerated drum. The pressure drum is positioned above the cooled drum

and is geared to it. Springs maintain the heated drum in contact with the other.

A scraper blade removes the newly-formed crystals from the cooled drum and passes them into a receptacle which may or may not be heated.

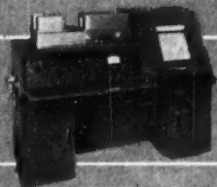
► **Two Or More Stages**—To obtain a product of higher purity it is necessary to go to a multi-stage unit. In multi-stage operation the crystal receiver is heated and the crystals remelted. Melt is sent on to the trough of the next stage. Here it is mixed with unfrozen mother liquor overflowing from a later stage and the entire mixture is re-crystallized.

The crystallization-remelting cycle is repeated until the desired separation, or desired product purity, is achieved. Crystals from the final stage are remelted and a portion returned to the operation at the trough of the final stage as recycle. The remainder is removed as product.

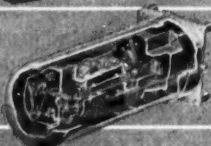
The degree of separation depends on several factors: among these are the number of stages, temperature at the various points in the operation and the drum speeds. These will vary depending on the material to be separated. Examples of the operation and operating data are given in some detail in the patent, U. S. 2,651,922. The inventor, Benton L. Graham, has assigned his patent to Phillips Petroleum Co.

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—For continuous control of liquid or gas streams. Records the ratio of any two wavelengths chosen. Thermostatted; enclosed in explosion-proof containers.



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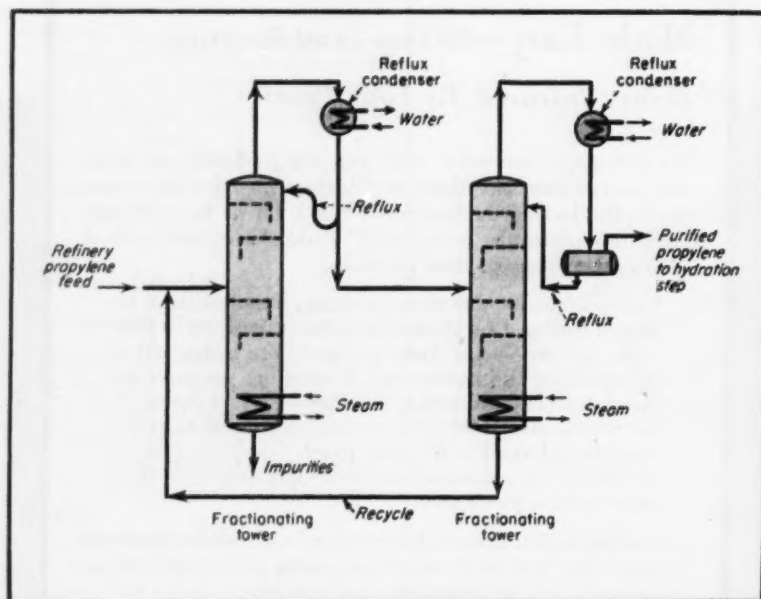
Many chemical companies "feel" they can profitably use infrared, but two questions linger on: "Is there enough work in our small plant to keep the instrument busy? Do we have the personnel to operate the instrument?" Perkin-Elmer has made it easy for you to answer these questions.

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Write for details of the trial program and the Model 12-C.





How to Get Pure Isopropanol

Here's a way to rid isopropyl alcohol of the undesirable odor which often degrades the product. Key is a high-pressure distillation to get top-purity propylene.

In the production of isopropyl alcohol by the hydration of propylene the product is often contaminated with butyl alcohols and other impurities. Though the amount of such impurities may be small and not objectionable from the standpoint of the industrial use of the product, they often contribute an undesirable odor which may degrade the product and render it unfit for some uses without further processing.

► **Contamination Limits**—To produce an isopropyl alcohol free of objectionable odor it is necessary to limit the amount of impurities in the propylene fed to the hydration process. The limit for C_4 hydrocarbon is 0.10 percent and for C_4 acetylenes it is 0.05 percent.

► **How It's Done**—The new method of removing these impurities from a refinery propylene fraction involves two successive fractionations at high pressure. Feed enters the first tower at a pressure of 330 psig. It is distilled into two fractions: Overhead consisting of propylene and a small

portion of the impurities—all at around 130 deg. F.—and bottoms, almost entirely impurities, at 240 deg. F.

Overhead from the first tower goes to the second. The pressure in this tower is held at 350 psig. Temperature and pressure are controlled to produce a liquid bottoms (at about 180 deg. F.) containing a substantial amount of propylene and the remaining impurities. This stream is recycled to the first-tower feed, impurities being eventually rejected along with bottoms from that fractionation.

► **Product Is Pure**—The overhead from the second fractionation tower (at about 130 deg. F.) is sent on to the hydration step for conversion to isopropyl alcohol. This overhead is virtually free of the C_4 acetylenes and C_4 hydrocarbons and can be used to make high-quality alcohol.

The new process was disclosed in U. S. 2,657,243 by the inventors, Albert P. Giraitis and Mack C. Fuqua. They have assigned the patent to Standard Oil Development Co.

New Wrinkle to Up Resin Production

A continuous process for the production of phenol-formaldehyde and other resins has recently been revealed. Actually the basic process steps are not new, but the inventors have come up with a few new tricks designed to up efficiency.

As usual, phenol and 37 percent aqueous formaldehyde are brought to the proper temperature and metered into a mix tank where they are agitated with the proper quantity of catalyst (such as sulfuric acid). Mix temperature is carefully regulated.

► **React in Coils**—Instead of passing the mixture to the conventional kettle reactor, it goes through a coil which is enclosed in a shell.

Tubing from $\frac{1}{4}$ in. to 2 in. I. D. is used for the coil. Depending on tube size, total lengths of from 400 to 1200 ft. are satisfactory for most commercial operations.

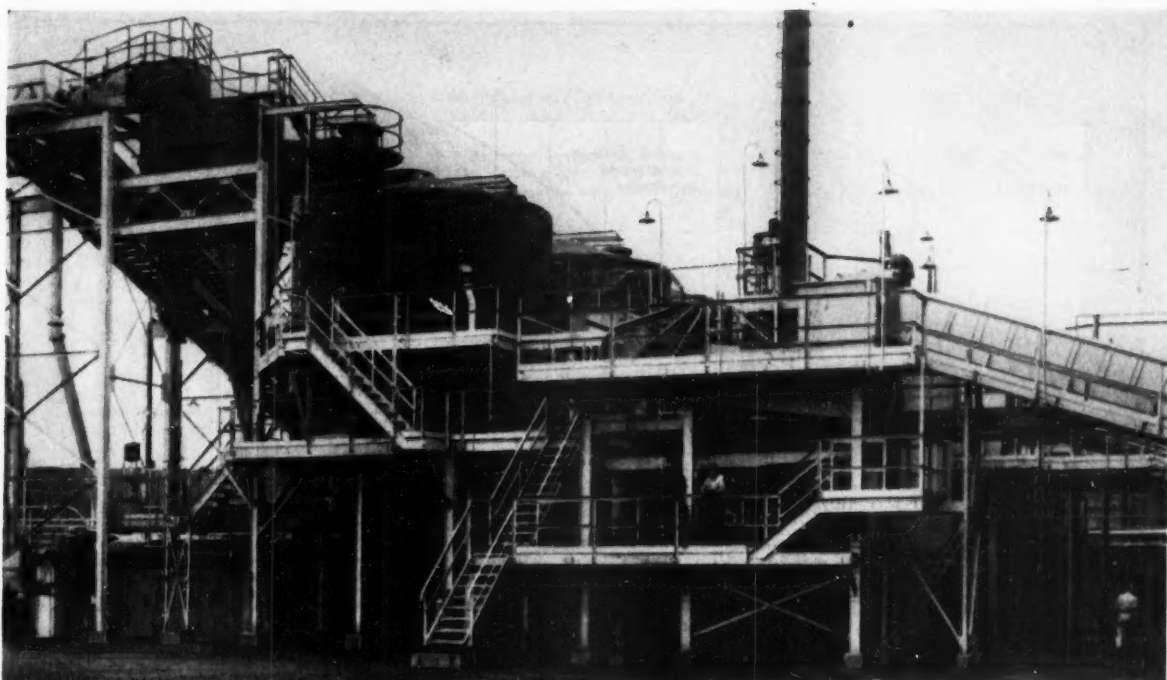
Steam on the shell side brings the reactant mixture to the proper temperature. Temperature in the coil is the major factor determining reaction time. It is adjusted to allow from 50 to 90 percent of the condensation to take place.

Holding the reaction short of completion in the first stage defers completion to a later stage, more easily controlled. Further, it prevents plugging of the coil by the formation of a viscous product. Linear velocities of 0.25 to 1.00 ft./sec. through the coil are preferred. Unless the reactants are of a volatile nature a pressure of about 25 psig. is sufficient. Agitating or scraping devices are not necessary.

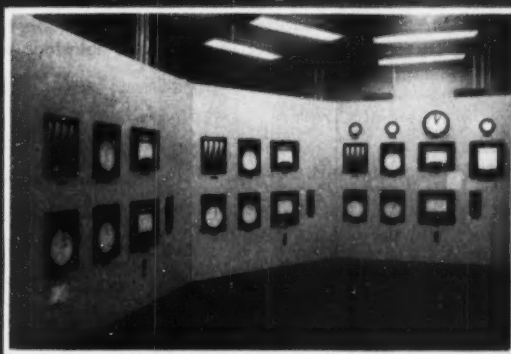
► **Cool and Separate**—Partially-condensed reactants discharge through coolers where the temperature is dropped below 50 deg. C. to arrest further reaction. The cooled mass passes to a separator and the resinous mass settles out.

Part of the aqueous upper layer, containing residual catalyst is drawn off and discarded. This is done to reduce the heating load in the next stage, facilitate dehydration of the resinous product and to slow the reaction rate in the next stage—by removing some of the catalyst.

Temperatures of 25 to 60 deg. C. are maintained in the separator to



Another **FIRST** for **FluoSolids**



The first commercial Dorco FluoSolids System for producing both SO_2 gas and a calcine for iron manufacture went on stream last summer at a large steel plant on the East Coast. Consisting of three 18' dia. Reactors and auxiliary equipment, this is also the first installation in the United States to go into operation with multiple units. A simple, flexible system provides for pyrite storage, pulping and holding tanks, and slurry feeding into the Reactors.

Feed contains 43 to 48% sulfur and is self-roasted at an operating temperature of 1650°F. A 13% SO_2 gas is produced which, after passing through cyclones, is scrubbed and sent to a 250 TPD contact acid plant supplying acid for the steel plant. Calcine is cooled and,

together with flue dust and fine ore, is sintered and charged to the blast furnace.

This installation is the latest in a long list of new applications for fluid technique. Other "firsts" for FluoSolids include arsenopyrite gold roasting, zinc concentrate roasting, providing a sulfating roast for copper-zinc concentrates, roasting sulfides for making cooking liquor in sulfite paper mills, and limestone calcination.

If you would like more information on FluoSolids — the most significant advance in roasting technique in the last 30 years — write The Dorr Company, Stamford, Conn., or in Canada, The Dorr Company, 26 St. Clair Avenue East, Toronto 5.

*FluoSolids is a trademark of The Dorr Company, Reg. U. S. Pat. Off.



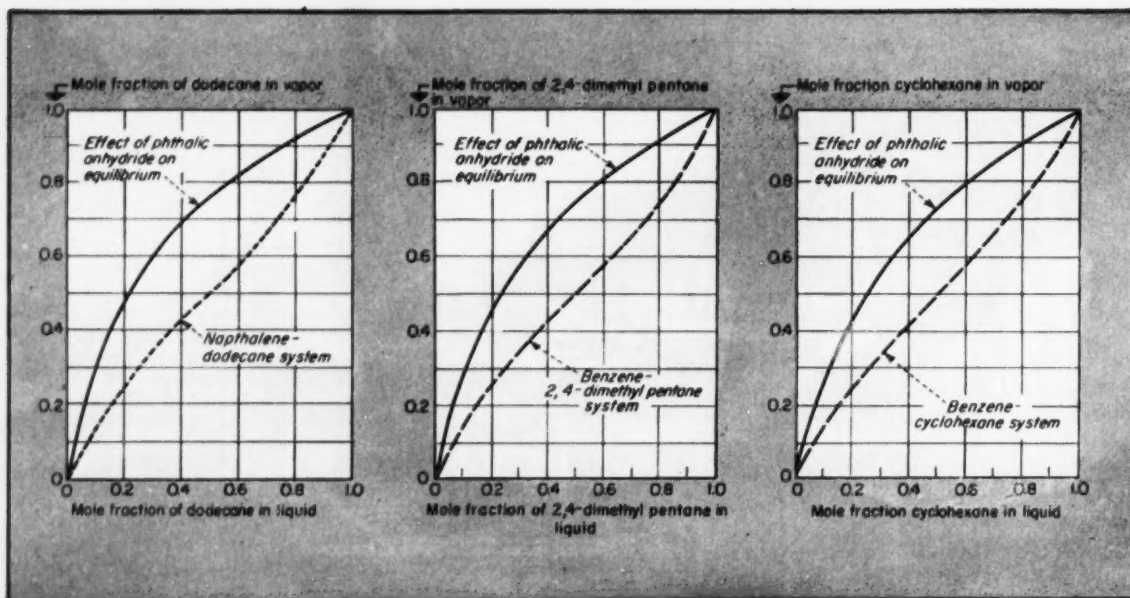
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MOLTEN PHTHALIC ANHYDRIDE may be used with telling effect as the entraining agent in the high temperature extractive distillation of aromatics from saturated hydrocarbons. The above curves show the effect of the molten anhydride on

the vapor-liquid equilibrium of the naphthalene-dodecane, benzene-2,4-dimethyl pentane and benzene-cyclohexane systems. The inventors, Hal B. Cooper and Eugene C. Medcalf, describe the method in U. S. 2,655,467, assigned to American Cyanamid.

(Resin Production, cont. . .)

cause separation of the two layers and still keep the mass warm enough to be fluid.

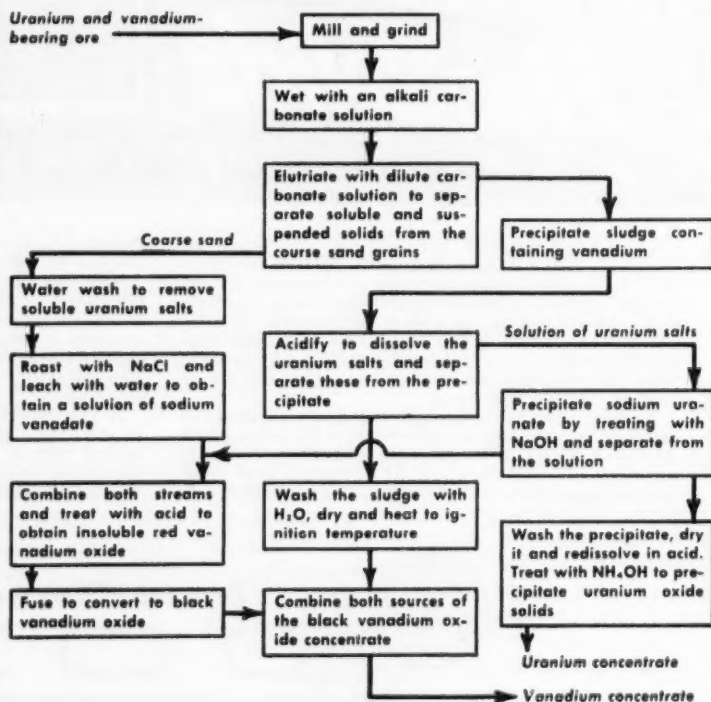
► **Complete the Reaction**—The lower layer, partially-condensed resinous material, and the remainder of the upper layer pass through another steam-jacketed coil—about 200 to 400 ft. long and 1 to 2 in. in diameter. The material is heated to 135-175 deg. C. at 15 to 30 psig. and the condensation completed.

Raising the temperature not only completes the reaction but also facilitates moisture removal from the product. Rate of feed to this reactor is kept high enough to prevent fouling.

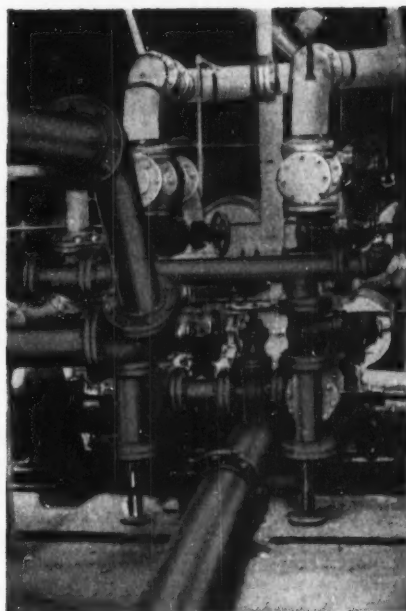
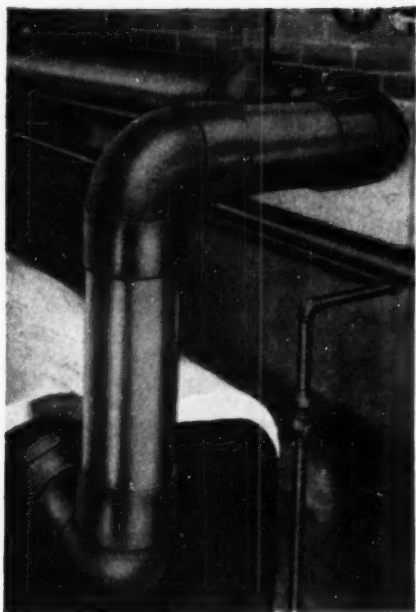
The product temperature is held high enough so that water and other unwanted constituents such as unreacted formaldehyde, will vaporize adiabatically when the mass enters a vapor separator. Just enough liquid is maintained in the separator to make a liquid seal at the discharge port.

The team of inventors, G. A. Coleman, R. B. Greene, J. H. Merriam, S. P. Miller and R. F. Shannon, give considerable detail and many examples of the process in their patent, U. S. 2,658,054. The patent is assigned to Allied Chemical & Dye Corp.

Uranium and Vanadium Concentrates From Low-Grade Ore



Described in U. S. 2,654,653 by Ralph D. Nye and Dana J. Demarest



Quick Quiz

on copper piping

Q

Isn't copper tubing more expensive to use than piping made of other materials?

A

In some cases, yes. In most cases, no. There are many conditions under which ANACONDA Copper Tube proves to be the *least* costly piping obtainable. Prevention of rust, corrosion and contamination, together with the lower labor costs of installing solder-type fittings, often more than offset differences in piping material cost.

Q

Why is copper tube easier to install?

A

There are many reasons. First, ANACONDA Copper Tube is light, easy to handle. Second, it comes in longer lengths, which saves cutting and fitting. Third, it is more flexible, can be bent on the job—again saving cutting and fitting. Fourth, required connections are fast and easy to make. No threading.

Q

Are changes in piping systems hard to make where copper tubing is used?

A

Definitely no. Once installed, copper tubes connected with solder fittings can be taken down, moved, or have new connections cut in faster and with less expense than with threaded pipe.

Q

Where can I get more facts?

A

A well illustrated booklet, "ANACONDA Copper Tubes for Industrial Applications," is available on request. It contains a wide range of information on copper tubes, their applications, advantages and installation. Numerous reference tables useful to user and installer are also included. For a copy of this booklet, ask for Publication C-24 and send your request to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.



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To assure long term service under the toughest operating conditions, all K & M diaphragms are molded of tough, inert neoprene and fabric reinforced.

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Your Checklist of New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No.
Chemical reaction	Apparatus to evenly distribute solid contact material	Phillips Petroleum Co.	2,655,273
	Chemical reaction tower	Colgate-Palmolive-Peet Co.	2,655,435
	Fluidized solids reactor	Hydrocarbon Research, Inc.	2,655,437
	Reaction furnace to contact a gas and fluidized solids	Standard Oil Co. (Ind.)	2,656,258
Crushing and grinding	Feed device for gyratory crushers	Allis-Chalmers Mfg. Co.	2,659,129
	Method of feeding rotary impact crushers	Herbert J. Woock	2,657,851
Extrusion and molding	Injection molding apparatus	Hahn & Kolb	2,659,567
	Injection molding apparatus	Produx Corp.	2,656,568-9
	Injection molding machine	Hartford National Bank & Trust Co.	2,657,429
	Production of expanded plastic articles	Extruded Plastics, Inc.	2,657,431
Filtration	Continuous rotary pressure or vacuum filter	Goslin-Birmingham Mfg. Co. Inc.	2,655,265
	Drainage attachment for leaf-type filters	Revere Sugar Refinery	2,656,930
	Centrifugal filtration	The Lummus Co.	2,657,803
Fluid and particle flow	Handling finely divided, fluidizable solids	Standard Oil Development Co.	2,655,411
	Conveying adsorption media by gravity	Metalgesellschaft Aktiengesellschaft	2,656,007
	Handling fluidized solids	Standard Oil Development Co.	2,656,242
	Elutriator for granular contact material	Houdry Process Corp.	2,656,920
	Pumping volatile liquids	Air Products Inc.	2,657,541
Heat transfer	Furnace for heating fluids	Universal Oil Products Co.	2,655,136
	Tube arrangements for heat exchangers	Union Carbide & Carbon Corp.	2,655,350
	Temperature control for plate heat exchangers	Aktiebolaget Separator	2,655,351
	Plate type heat exchanger	The Air Preheater Corp.	2,656,158
	Laminated heat exchanger	The Air Preheater Corp.	2,656,159
	Cooling tower unit	Robert O. Ayres	2,656,168
	Indirect heat exchange with solids	Kaiser Aluminum & Chemical Corp.	2,657,473
Mixing	Centrifugal apparatus for gas-liquid mixing	Eereumeus Melotte, Societe Anonyme	2,657,025
	Device to mix liquids and fine solids	Troy Engine & Machine Co.	2,657,911
	Bearing support for vertical agitating shafts	Dravo Corp.	2,657,912

. . . And New Process Patents

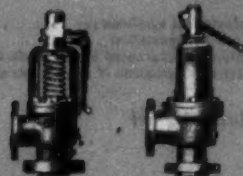
Product . . .	Process . . .	Inventor or Assignee . . .	Patent No.
Carbon black	Treatment to reduce furnace black pH	Phillips Petroleum Co.	2,657,117
	Production of furnace carbon	Columbian Carbon Co.	2,656,254
Catalysts	Preparation of alumina-gel catalysts	American Cyanamid Co.	2,657,184
Fats and oils	Refining vegetable oils	Aktiebolaget Separator	2,657,224
Fuels	Removal of nitrogen from natural gas	Phillips Petroleum Co.	2,656,010
	Making calorific gas from coal	Institute of Gas Technology	2,656,264
	Distillation of oil shale	Institute of Gas Technology	2,656,308
	Gasification of coal	Phillips Petroleum Co.	2,657,501
	Production of water gas	Standard Oil Development Co.	2,657,986-7
	Retorting oil shale	United States of America	2,658,061
Gases	Low-temperature separation of gaseous mixtures	Union Carbide & Carbon Corp.	2,655,796
	Separation of chlorine from CO ₂ by absorption	Sauerefabrik Schweizerhall	2,658,011
	Manufacture of HCN	American Cyanamid Co.	2,656,251
	Manufacture of hydrogen	The M. W. Kellogg Co.	2,656,255
Hydrocarbons	Production of nitrogen oxides	Wisconsin Alumni Research Foundation	2,657,116
	Petrochemical production of olefins	Standard Oil Development Co.	2,655,474
	Fractionating aromatic hydrocarbons	California Research Corp.	2,658,310
	Isomerization and separation of xylenes	Shell Development Co.	2,656,397
Inorganic chemicals	Separation of ethane from hydrocarbon mixtures	Phillips Petroleum Co.	2,657,761
	Producing calcium sulfide from refinery waste acid	Shell Development Co.	2,655,430
	Sulfuric acid production by absorption	Chemical Construction Corp.	2,655,431
	Salt crystallization	Diamond Crystal Salt Co.	2,655,438
	Preparing sodium salts of carbonic acid by ion exchange	Rayonier Inc.	2,656,245
	Ammonium sulfate production	Phillips Petroleum Co.	2,656,247-8
Organic chemicals	Manufacture of alkali metal-free alumina	American Cyanamid Co.	2,657,115
	Production of monoesters of polyhydric alcohols	Colgate-Palmolive-Peet Co.	2,655,522
	Preparation of naphthaleneacetic acid	Food Machinery & Chemical Corp.	2,655,531
	Alkylation of phenols with polypropylene	Standard Oil Development Co.	2,655,544
	Preparation of tertiary alkyl aryl ethers	Gulf Research & Development Co.	2,655,546
	Production of alkylphenols	The Dow Chemical Co.	2,655,547
	Photochemical production of benzene hexachloride	Ethyl Corp.	2,656,313
	Preparing dialkyl sulfides	Phillips Petroleum Co.	2,656,392
	Preparation of nitroolefins	E. I. du Pont de Nemours & Co.	2,656,395
	Controlled heterogeneous hydrolysis of polymeric esters	E. I. du Pont de Nemours & Co.	2,657,201
	Production of tetraethyl lead	E. I. du Pont de Nemours & Co.	2,657,225
	Preparation of amino acids from proteins	Armour & Co.	2,657,232
	Separation and recovery of methyl amines	Southern Production Co., Inc.	2,657,237
	Manufacture of tetramethylethylene	Sharples Chemicals Inc.	2,657,245
	Ethylene polymerization in the vapor phase	Standard Oil Co. (Ind.)	2,658,059
	Chlorination of cyclopentadiene	Arvey Corp.	2,658,085
	Chlorination of olefins in dilute mixtures	Chempatents, Inc.	2,658,087-8
Resins	Producing olefins by dechlorination of alkyl chlorides	Ruhrchemie Aktiengesellschaft	2,658,090
	Production of tetrahydrophthalic acid resins	Frederick A. Stresen-Reuter, Inc.	2,655,486
Rubber	Refining hydrocarbon resins	Pan American Refining Corp.	2,656,303
	Preparing synthetic rubber-carbon black mixtures	United States Rubber Co.	2,658,049
	Plasticizing rubber	E. I. du Pont de Nemours & Co.	2,658,091
	Rubber processing	United States Rubber Co.	2,658,092
Synthesis gas and synthesis products	Manufacture of synthesis gas	Phillips Petroleum Co.	2,655,442
	Synthesis gas generation	The Texas Co.	2,655,443
	Separation of oxygenated organic epds. from hydrocarbons	National Distillers Products Corp.	2,657,227
	Selective hydrogenation of oxo-process aldehydes	Standard Oil Co. (Ind.)	2,658,083

Another Milestone... the



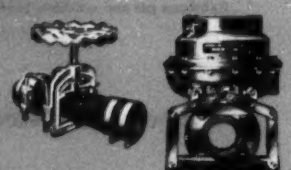
**FARRIS
ENGINEERING
CORP.**

Safety & Relief Valves

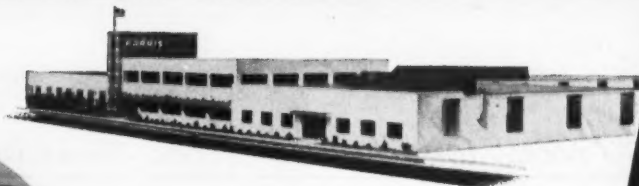


**FARRIS
FLEXIBLE
VALVE CORP.**

Pinch Type Flexible Valves



new home of



Farris

AFFILIATED COMPANIES

This plant, on a 4 acre tract, is more than an expansion, it is in fact a living thing . . . visual proof that growth in the American way is the simple result of straightforward, sincere effort in giving appreciative customers their money's worth.

In this air-conditioned plant, equipped with the very finest of automatic machinery, we now feel that we have established another milestone; yes, a foundation stone from which our next decade of growth should stem.

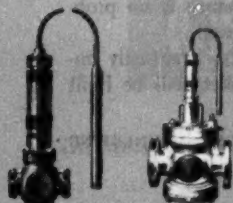
Thanks to you, our customers and friends. Thanks to you, our staff, who have truly made the term man-power vibrant.

We shall always keep our operations simple and direct. This effort and thinking has been, and always will be, well rewarded.

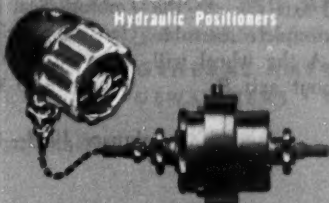
W. J. Farris



**FARRIS
STACON CORP.**
Temperature Regulators



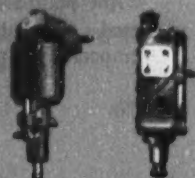
**FARRIS
HYDROTORQUE
CORP.**
Hydraulic Positioners



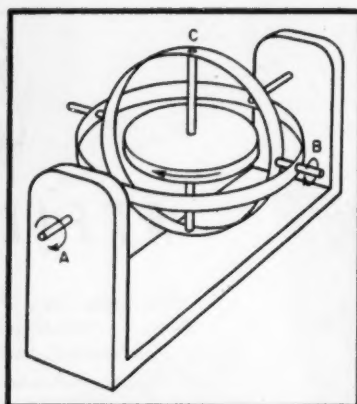
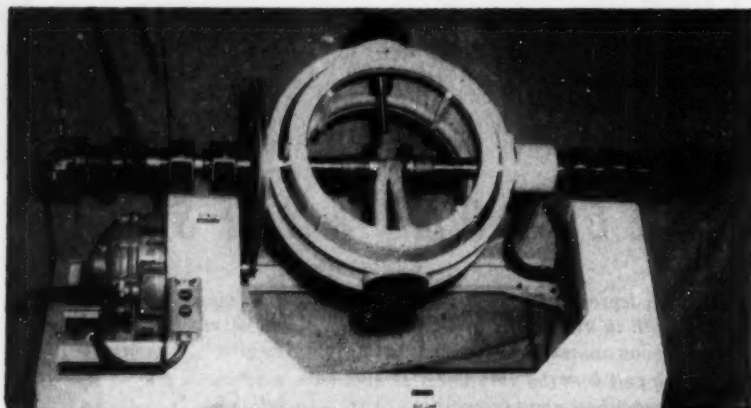
**FARRIS
HYDROSEAL
CORP.**
Elastic Piston Seals



**FARRIS
PICKERING
GOVERNOR CO.**
Mechanical & Hydraulic Governors



NEW INSTRUMENTS & CONTROLS



MASS FLOW meter uses fluid momentum in circular pipe to simulate action of . . . GYROSCOPE and obtain flow rate.

Precession to Mass Flow Rates

Maybe the parade to mass flow rate measurement has started. If so, you'll want to know how the precession of a gyroscope leads to an accurate reading of mass rate.

Remember the peculiar antics of that toy gyroscope you pulled out of your Christmas stocking many years ago? You can recall now how it seemed to gain a mind of its own once it started spinning. Either it resisted your attempts to change its position or it moved in a rather unpredictable direction.

One of the characteristic motions of a gyroscope reacting to external force is called precession. In the new Gyro flowmeter, gyroscopic precession is utilized to give true mass flow rate metering.

Control Engineering Corp., already a pioneer and dominant figure in techniques of mass flow metering (*Chemical Engineering*, Mar. 1953, p. 124), feels the Gyro meter incorporates some hard-to-beat features. Weight flow of gases (min. pressure 25 atm.), liquids and mixtures thereof are sensed directly without intermediate corrections. Other systems such as fluidized solids and liquids or gases containing limited quantities of suspended solids also can be measured.

Any pumpable material can be metered without interference from temperature, pressure or viscosity;

these variables have no effect on the measurement.

Electrical signal output from the meter is sufficiently strong to permit operation on remote location without amplifications. Response is linear and effective up to 10 cycles per sec.

Accuracy is 4 percent of full scale for integrated flow, 1 percent of full scale for indicated flow with simple indicators; 4 percent of full scale for indicated flow using potentiometer indicators.

First commercial models of the Gyro flowmeter have been built and operated. However, before the instrument is offered for sale during the second half of 1954, it will undergo extensive testing and design modification. While initial models are fully operable, Control's engineers are striving for a plant instrument that will run continuously 18,000 hr. without maintenance.

For an understanding of how a Gyro flowmeter works refer to the gyroscope sketch above. The gyroscope wheel spins around axis C. At the same time if the complete assembly rotates about axis A the wheel will precess, rotating about axis B.

Assume that rotational speed around axis A is constant. Then the torque which produces precession about axis B will be proportional to the angular momentum of the gyro wheel spinning on axis C.

Comparing the Gyro flowmeter with the gyroscope we find the gyro wheel replaced by a pipe formed into a circle. Movement of material flowing through the circular pipe corresponds to a rotating gyro wheel. If the complete assembly then is rotated about axis A, torque will be produced about axis B in direct proportion to the mass flow.

Behavior of the flowmeter may be expressed by

$$T = 2\pi M\omega cr^2$$

where T is torque, M is mass rate of flow, ω is angular or rotational velocity, c is the number of turns in the pipe coil and r is the radius of the pipe coil circle.

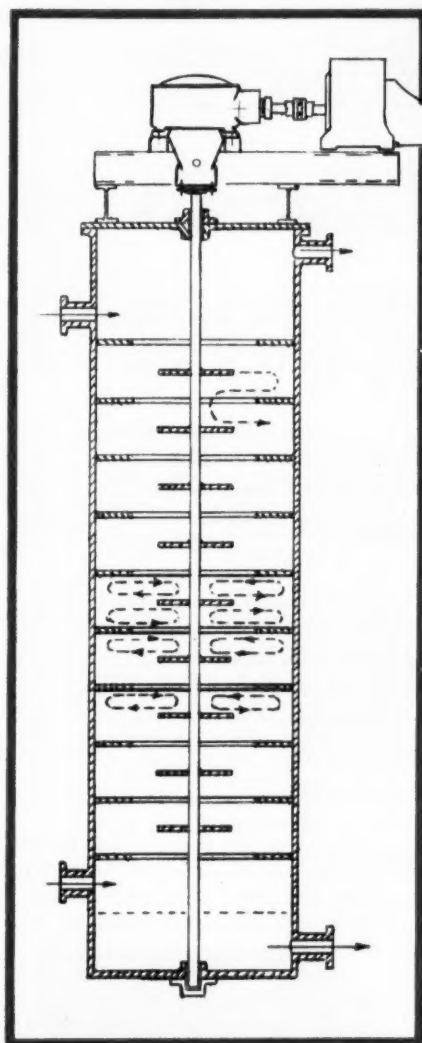
Torque forces are converted into electrical signals as strong as 30 v. by an electromagnetic torque transducer located on axis B. Signals of this magnitude require no amplification even for transmission over appreciable distances. Standard indicating, recording and controlling equipment can be used with the meter.

Constant rotational speed of 200 rpm. is furnished by a synchronous motor. Seal maintenance is no problem with such low speed.

Production models, eventually introduced to the market, will be built



TURBO-MIXER, a division of
GENERAL AMERICAN TRANSPORTATION CORPORATION



**Licensed under Shell
 Development Company patent*

Turbo-Mixer R.D.C.* Column

**Rotary Disc Contactor for
 Liquid-Liquid Counter-current Extraction**

Six years of data and design development in the laboratory, pilot plants and industry have demonstrated the superior features of this practical counter-current and gravity flow extractor. The R. D. C. extractor offers:

1. high volumetric efficiency
2. high throughput capacity
3. simplicity of construction
4. no interstage or external settlers
5. low power requirements
6. flexibility of operation

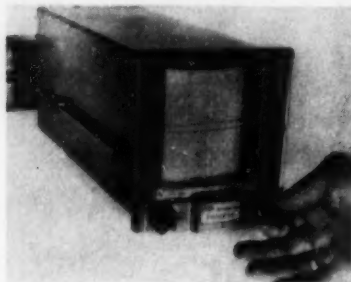
May we assist you in the solution of your extractor problems? Our laboratory facilities are available for evaluation of your extraction system.



SALES OFFICE: 380 MADISON AVENUE, NEW YORK 17, NEW YORK
General Offices: 135 S. La Salle St., Chicago 90, Illinois • Offices in all principal cities
**OTHER GENERAL AMERICAN EQUIPMENT:—DRYERS • EVAPORATORS
 DEWATERERS • TOWERS • TANKS • PRESSURE VESSELS**

NEW INSTRUMENTS & CONTROLS

in sizes for flows ranging from 300 lb. per hr. to 200,000 lb. per hr.—Control Engineering Corp., 570 Providence Highway, Norwood, Mass.



Miniature Recorder Receives Four Variables

Designed for standard graphic or semi-graphic panel mounting, a new miniature recorder can receive four variables. Conventional instruments are capable of receiving only three.

Instrument can house a maximum of four simple pneumatic receivers. It can record two variables and indicate two more or record three variables and indicate the fourth.

To transform the Ratographic recorder into a recording controller, a standard field-mounted pneumatic control may be plugged into the back of the recorder chassis. A large external automatic-manual transfer knob and a set point knob allow easy adjustment and bumpless transfer. Set point indication is obtained pneumatically from the set point pressure regulator line to the controller.

Instrument takes 6x6 in. of panel space; uses a 4-in. rectilinear strip chart available with electric or pneumatic drive.—Fischer & Porter Co., 13 Jacksonville Rd., Hatboro, Pa.

Analog Data Recorder Has Wide Versatility

A modification of a time-tested analog data recorder provides wide versatility in measuring analog quantities. The Ametron recorder prints virtually any physical quantity capable of being converted into a corresponding voltage.

Recorder prints information in the form of digits. It may operate remotely. Instrument can be switched from one sensing device to another to print data either automatically or by manual selection.

IN BRIEF—A capsulated listing of this month's newsworthy equipment.

New Instruments & Controls

	Page
Mass Flow Meter	Utilizes gyroscopic precession to give rate.....270
Miniature Recorder	For graphic panels can receive four variables.....272
Analog Data Recorder	Receives and prints process data as digits.....272
Load Cells	Using strain gages are now more accurate.....272
Thermocouple Circuits	That are faulty can be restored instantaneously.....274
Multi-Point Recorders	Built for either 6 or 24 point recording.....274
Pneumatic Transmitters	Feature rapid range change and interchangeability.....274
Thermometer-Transmitter	Combines mercury thermometer and air transmitter.....274

New Materials of Construction

Protective Sheet	Of rubber protects metal from abrasive pounding.....276
Kel-F Film	Now can be used for tank lining jobs.....276
Opaque Silica	Furnished in regular shapes to close tolerances.....276
Neoprene Coating	Applies as thick film, cures without heat.....276
Tank Coating	Protects giant storage tank from weathering.....276

New Electrical & Mechanical Equipment

Electric Motors	Completely redesigned to new standards.....278
Variable Speed Drives	In two new types for 20 to 25 hp. applications.....278
Pipe Thread Sealer	Is formulated of chemically inert Teflon.....278
Mechanical Rectifier	Has proved very stable with long contact life.....278
Glove Dryer	Returns washed gloves to service quickly.....278

New Safety Equipment

Sure-Footed Rubber	Of neoprene has suction cups in soles.....280
First Aid Kit	Designed for quick use without confusion.....280
Fire Extinguisher	Carries pictorial operating instruction label.....280
Foam Proportioner	Delivers choice of water, wet water or foam.....280
Fire Hose	With glass fiber carcass is lighter, bigger.....280

New Heating & Cooling Equipment

Steam Generator	In compact package runs on oil or gas.....282
Axial Blower	Moves contaminated hot air for long periods.....282
Ventilating Wheel	Transfers heat between entering and leaving air.....282
Rotating Steam Joint	Is lighter, smaller, packless, self-adjusting.....282
Plate-Type Coils	Offer inexpensive tank cooling and heating.....282
Centrifugal Coolers	Now built in 75 to 200 hp. sizes for small jobs.....282

New Processing Equipment

Centrifugal Contactor	Used for multi-stage, liquid-liquid extraction.....284
Dry Blender	For laboratory has clear, plastic, double cone.....286
Nitrogen Generator	Operates at lower cost, thanks to redesigning.....286
Paper Stock Feeder	Eliminates sticking and clinging to stock chest.....286
Dispersion Mixers	In 30 to 300 gal. size have new drive units.....286
Continuous Centrifugal	Is flexible to meet process changes.....286
Heavy Duty Mixer	In 1- and 1½-ton sizes for wet or dry materials.....286
Tower Packing	In form of Raschig rings made of Kel-F.....286

New Fluids Handling Equipment

Hermetically Sealed Pump	Has unique fluid-piston bearings to carry load.....288
Dust Tube Blow Rings	Adjust automatically to filter-tube contours.....290
Diaphragm Pump	With simplified design offered as package.....290
Proportioning Pump	Has low cost easily replaceable liquid end.....290
Compressor	Has sectionalized cylinders, valves in head.....290
Welding Sequence	Provides superior installation of jacketed pipes.....290
PVC Reagent Feeder	Has low initial cost and high corrosion resistance.....290
Molecular Vacuum Gage	For panels combines detector and gage integrally.....292
Centrifugal Pump	Has rubber liner to withstand abrasives and acids.....292
Rubber Equipment	Is manufactured in both natural and Buna N.....292
Three Valve Manifold	Reduces connections 12 to 2.....292
Plastic Pump	Is self priming, inexpensive and long lived.....292

Unit is based on a continuous balance type of servo system. A potentiometer is automatically adjusted to each change in recorder input voltage. Basic elements include balancing bridge, a zero balance adjustment, a three-stage amplifier and a two-directional balancing motor.

A precision step cam system is rotated by the balancing motor to positions proportional to the recorder input voltage. A set of precision me-

chanical sensing fingers linked to the printer mechanism move in to engage the cam. The print hammer then snaps down and prints the exact values.

Among the sensing devices used with this recorder are tachometer generators, thermocouples, load cells and pressure cells.—Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.

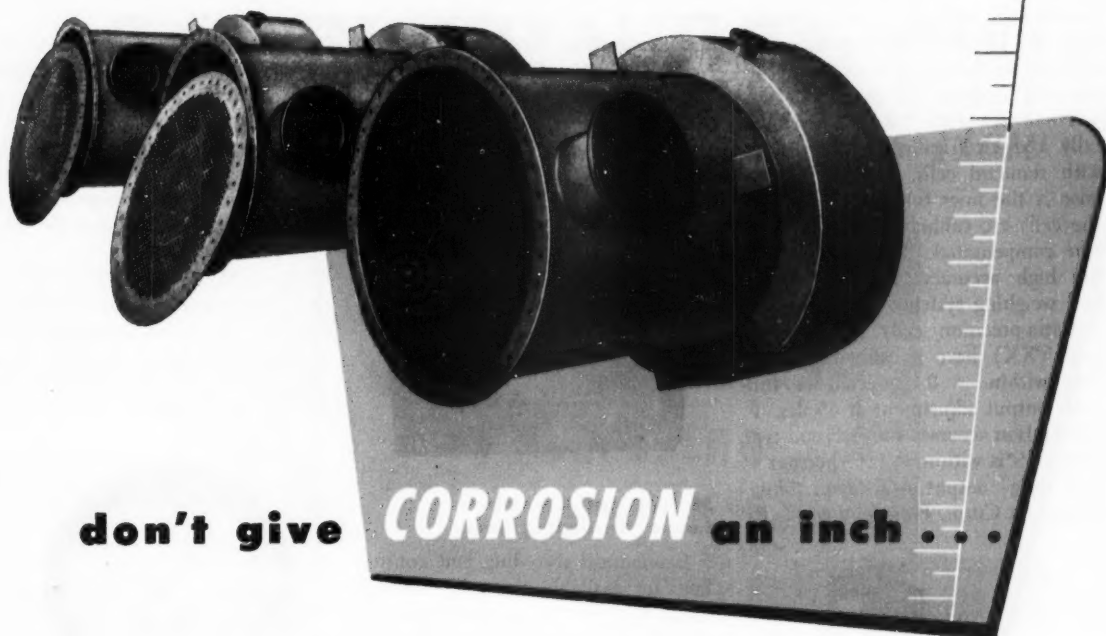
Strain Gage Load Cells Now Have More Precision

Two new series of precision and extra-precision Type SR-4 load cells now are available for measuring force

MARSHALL STEVENS INDEX

See page 364

Hard rubber lined
chlorine gas coolers



don't give **CORROSION** an inch . . .

. . . IT MAY TAKE A **mile**

Ever stop to think how much of your plant could be taken out of service by a pinhole failure in a vital fitting, tank, or valve? The average pump failure, for example, was found to cost \$125 according to one survey. We know of cases where more than a mile of piping and equipment has shut down when corrosion struck one small, unprotected spot.

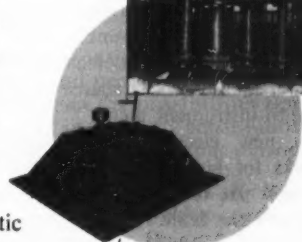
In Ace hard rubber protected equipment there are no loopholes for pinholes. The protection you buy gets 20 rigid inspections, developed through 100 years of experience with this finest of corrosion-resistant materials. In one test, a piece from the same batch of rubber, bonded and vulcanized at the same time as the lining, goes to the laboratory for complete breakdown analysis just to make sure.

Many types of Ace rubber and plastic materials are available in a wide variety of standard or special equipment for complete chemical processing, storage or circulating systems. Write for bulletins.

Hard rubber pipe
and fittings handling
zinc chloride



Special chlorine
cell cover has high
heat and chemical
resistance



more RESISTANT
TO more CHEMICALS



ACE[®] rubber and plastic products

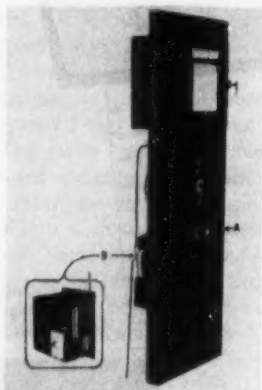
AMERICAN HARD RUBBER COMPANY
93 WORTH STREET • NEW YORK 13, N. Y.

NEW INSTRUMENTS & CONTROLS

and weights. Compression cells are available in nine capacities ranging from 500 to 200,000 lb.; tension load cells can be furnished in eight capacities ranging from 500 to 100,000 lb.

These new load cells are mechanically and electrically interchangeable with standard cells. Essential difference is the finer tolerances to which the cells are calibrated and temperature compensated. This makes possible high accuracy, force measuring and weighing systems.

Extra-precision cells (Type CXX and TXX) have a calibration accuracy within ± 0.1 percent of full-scale output adjustment at 65 deg. F. Calibration accuracy for precision type load cells is within ± 0.15 percent of full-scale output. — *Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.*



Faulty Thermocouple Circuits Restored Instantaneously

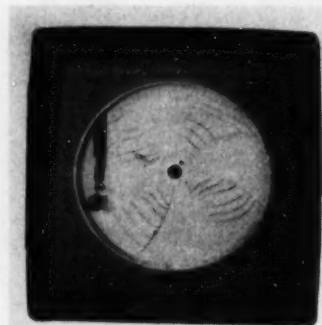
Poor connections in thermoelectric pyrometers are a common cause of errors. Checking and detecting of the fault long has been a source of annoyance to instrument men.

A new electrical device quickly checks for faulty circuits or thermocouples. At the same time it is said to repair the fault.

Circuit is checked and repaired simply by pressing a button at (A). This causes the Restorer at (B) to send a pulse of electrical energy through the thermocouple circuit. This energy bridges the loose, corroded and defective joint. A true temperature reading then is obtained. Difference in reading before and after use of the Restorer indicates a fault.

Device is available for either manual or automatic operation. It can be used on any kind of thermocouple

wire. One unit can be used for a number of thermocouple circuits. — *Sherman Electric Co., 1807 Elm Rd., N. E., P. O. Box 551, Warren, Ohio.*



Multi-Point Recorders Lower Recording Costs

Economical recording and controlling are available through two new multi-point recorders. These circular chart instruments can be furnished for either 6-point or 24-point recording.

Each unit is equipped with a 6-point turret pen to provide six different colored traces. The full cycle for 6 points on the standard unit is accomplished in 30 sec.

On the 24-point recorders there is a combination of 6-point and segmental recording. Circular chart is divided into four segments each equivalent to either 8 hr., 24 hr., or 7 days. On each segment six different color traces are drawn. The 24-point cycle on the standard unit is accomplished in two minutes.

When the cycling mechanism is switched off the multi-point recorder operates as a normal single-point recorder. It is said this feature has never been provided in any other multi-point unit.

This multi-point recording feature is available either with the A.C. Self Balancer or the Tektolog recorder. — *Fielding Instrument Div., Robertshaw-Fulton Controls Co., 2920 North Fourth St., Philadelphia 33, Pa.*

Pneumatic Instruments Require Less Service

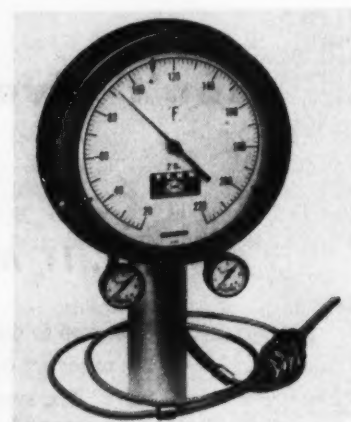
The Metagraphic pneumatic transmission instruments are designed for measuring, indicating, recording and controlling pressure, temperature,

vacuum, flow, differential pressure and liquid level.

These instruments have fewer moving parts, require fewer adjustments and less service. Range changes can be made in seconds.

All components are interchangeable. Units can be combined like building blocks to make any arrangement; functions can be located exactly where they are needed.

Plug-in designs permit replacement of a component without stopping any process. An automatic sealing system prevents loss of air pressure during changeovers. — *The Bristol Co., Waterbury 20, Conn.*



Dial Thermometer Combined With Transmitter

A high-grade dial thermometer has been combined with a rugged pneumatic transmitter in a new indicating temperature transmitter. By combining transmitting and indicating functions the need for long lengths of capillary tubing or additional indicators is eliminated.

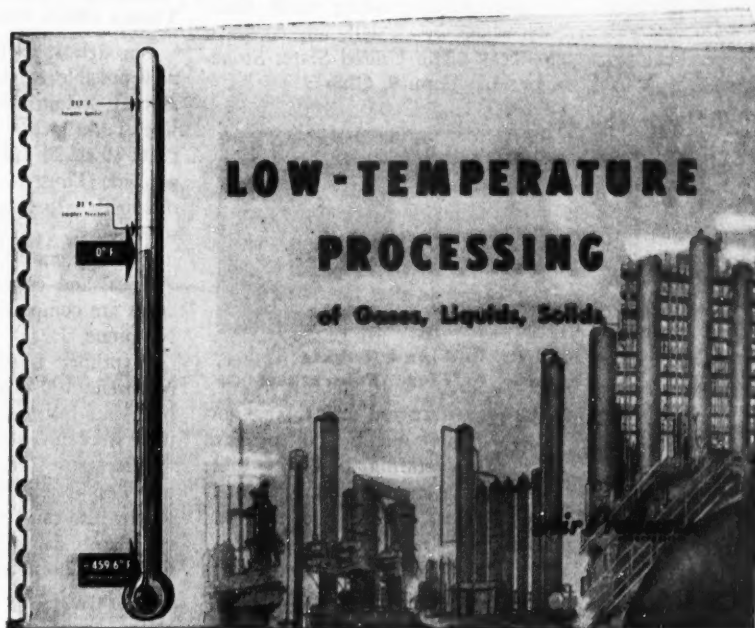
Any number of receivers can be operated by a single transmitter, thus it is possible to indicate, record or control temperatures simultaneously at several different plant locations.

Dial thermometer has an evenly graduated 8-in. diameter scale. Mercury cell thermal system is suitable for temperature ranges from -40 to $1,000$ deg. F.

A wide variety of bulbs and sockets can be furnished. Standard air output range of the pneumatic transmitter is from 3 to 15 psig. Other ranges are available. — *Penn Industrial Instrument Corp., Penn Bldg., 4110 Haverford Ave., Philadelphia 4, Pa.*

Take Dollars Out Of Waste Gas, Natural Gas, Air

This New 36-page Brochure Tells How



GAIN NEW PROFITS thru low-temperature separation
of fluid mixtures . . .

UTILIZE petroleum fluids, coke oven gas, natural gas,
air . . .

PRODUCE hydrogen, nitrogen, oxygen, ethylene,
ammonia synthesis gas, many others.

SEE the broad opportunities open to industry . . . read
how you can find out your possibilities.

Air Products

INCORPORATED

Specialists in Low-Temperature Processing

Estimates • Process Design • Apparatus Design • Apparatus Manufacture

Extremely low temperatures—down to $-450^{\circ}\text{F}.$ —are today finding use in many industries . . . chemical, petroleum, petrochemical, steel, electronics, industrial gas. They are being used to recover valuable chemicals from previously wasted or neglected mixtures . . . to widen profit margins over other recovery methods . . . to store gases at less cost.

This new brochure explains the broad opportunities . . . illustrates present and probable applications. It tells how you can find out the possibilities open to your company . . . get answers on separations . . . capital and operating costs . . . pay-out periods.

A special section on air plants features *Air Products* Generators that make oxygen-nitrogen-argon *simultaneously*. Another shows *Air Products* Low-Temperature Apparatus—available in many standard and special types and sizes.

Air Products, Incorporated, Dept. F, Box 538, Allentown, Pa.

Please send me a copy of your new brochure, without obligation.

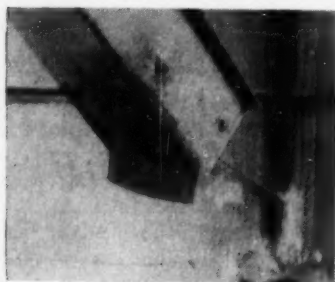
Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....

NEW MATERIALS OF CONSTRUCTION



Rubber Protective Sheeting Takes Abrasive Pounding

A new rubber protective sheeting is especially effective for combatting abrasion and corrosion. Iron-Rubber is being used on chutes, hoppers and launders, bar mills, ducts and pipes, skips, housings, tanks and shaking tables.

Advantages claimed are minimized maintenance cost, increased equipment life and increased production by eliminating shutdowns for time-consuming repairs.

Iron-Rubber sheets can be furnished in any thickness and length up to 36 in. wide. The reinforced type is composed of two sheets of rubber permanently bonded to a central core of expanded steel. This type can stand on edge without buckling, can be bent to fit corners without springback or can be shaped to fit practically any contour. Non-reinforced material is a single sheet of rubber which is much more flexible than the reinforced type. —Magic Chemical Co., 121 Crescent St., Brockton 2, Mass.

Kel-F Plastic Film Now Used for Tank Lining

Recent development of a welding method for Kel-F film makes it useable for lining tanks to safeguard against corrosive attack. Welding procedure is only successful in bonding the film to itself. Lining must be supported inside tanks by an acid-brick structure.

Standard thickness of the Kel-F membrane is 0.005 in. To protect the film from mechanical damage during installation a special procedure has been evolved.

First, the Kel-F is pre-fabricated into a custom-designed envelope, complete with outlets. Next, the Kel-F envelope is encased in a similar envelope of vinyl or polyethylene plastic;

another vinyl or polyethylene envelope is inserted into the Kel-F liner. The assembled sandwich then is installed in the tank and over-sheathed with acid-brick and cement.

Despite cost of this procedure compared to conventional rubber or plastic linings it is a thoroughly satisfactory method of safeguarding costly tanks from attack by virtually any corrosive chemical.—The United States Stone-ware Co., Akron 9, Ohio



Silica Rod and Tubing Made to Close Tolerances

Opaque silica rod and tubing now boast some new qualities. By means of new manufacturing processes these items can be supplied with absolutely regular shapes, precise tolerances and thoroughly glazed surfaces.

Precision of bore and wall thickness opens new uses which previously could

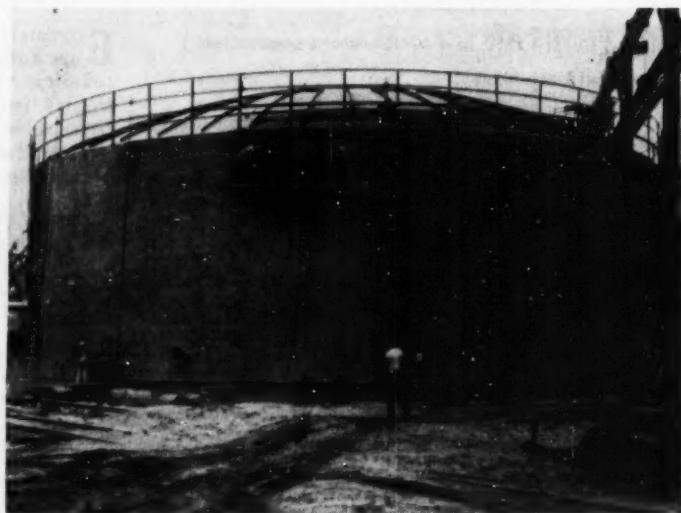
not be considered. Super-smooth surface and uniformity are important characteristics in minimizing devitrification at high temperatures.—Quartz Products Corp., 25 Crows Mills Rd., Keasby, N. J.

Neoprene Coating Formula Yields Thick Film

Through special formulation it is now possible to eliminate the 10- to 20-coat system formerly required to line tanks with Neoprene. Brush coats 10 to 20 mils thick now can be applied. Thus $\frac{1}{8}$ in. linings can be obtained with application of four to seven coats.

Coatings cure at room temperature. Physical and corrosion-resistant properties are comparable with heat-cured Neoprene.

A primer developed for use with Neoprene 100 coating is suitable for both sandblasted and wire-brushed rusty steel surfaces. Primer is resistant to direct corrosion, creep corrosion and provides excellent edge protection. Primer also can be modified for applications on damp surfaces—Carboline Co., 331 Thornton Ave., St. Louis 19, Mo.



GIANT STORAGE TANK GETS A WINTER COAT

Acid wastes stored in this 120 by 60 ft. tank can't chew out the inside because it is rubber lined. And the protective coating being applied to the exterior will keep the outer surface safe from weathering. Applied over a sandblasted surface to a thickness of $\frac{1}{4}$ in. the Palladium Mastic Type 3X forms an insulating, waterproofing, acid and alkali resistant coating. It's compounded from a gilsonite base, cork, asbestos and ceramic clays.—Emjay Maintenance Engineers, 327 Union Ave., Rutherford, N. J.

How Armco ALUMINIZED Steel Solved a Contraction Problem

Before this stack connected with a high-temperature fractionating column was sheltered by a rain-shield made of Armco ALUMINIZED* Steel, driving Gulf Coast rains were a serious hazard. The stack operated normally at 700 degrees F, but semi-tropical rains would cool the windward side down to 300 to 400 degrees F, while the lee side of the stack remained at operating temperature. Uneven contraction would cause the stack to bow.

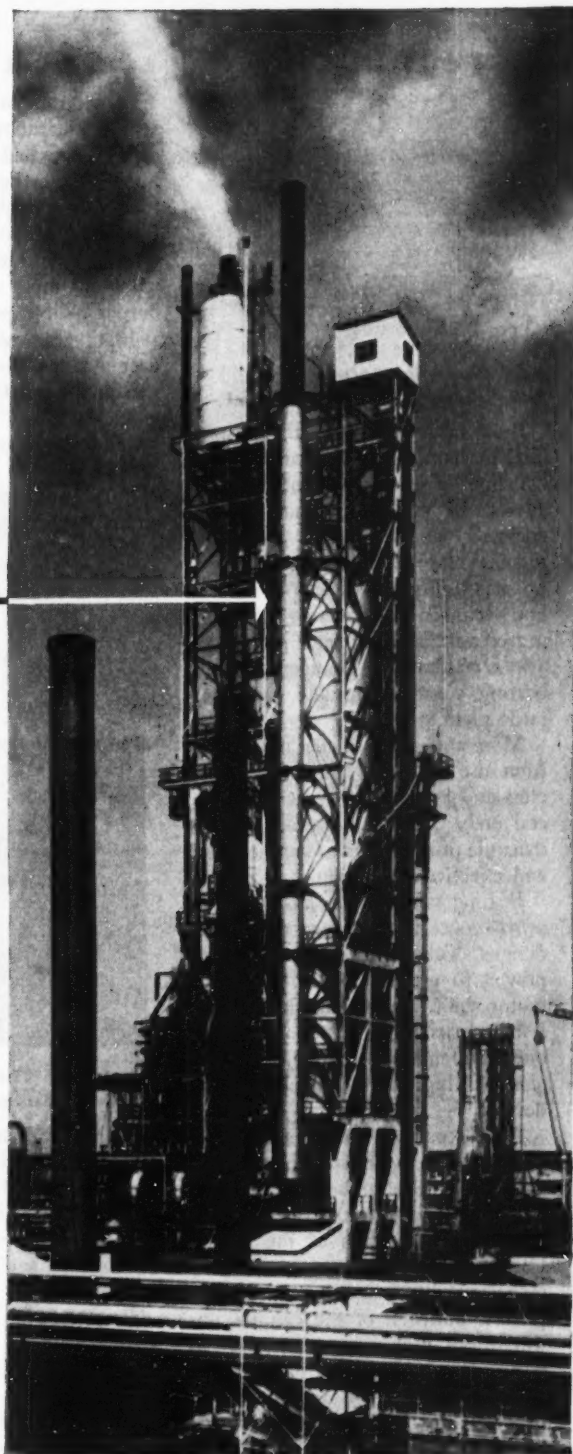
SOLVED CRACKING PROBLEM

Structural supports were rigid and would not permit much movement of the stack. Yet something had to give, so cracking of the stack was an ever-present threat. To protect the stack from failure, it was fitted with a shield of Armco ALUMINIZED Steel with an airspace between shield and stack. This protected the stack from wind and rain, prevented uneven contraction and solved a serious problem for the oil refinery.

HEAT- AND CORROSION-RESISTANT

Its combination of heat- and corrosion-resistance makes Armco ALUMINIZED Steel ideal for many applications like this. At temperatures up to 900 degrees F it is used for heat reflection; at higher temperatures it becomes an excellent radiator of heat.

For more information on this special aluminum-coated steel, phone the nearest Armco District Office or write us at the address below.



An Armco ALUMINIZED Steel raincoat for a stack

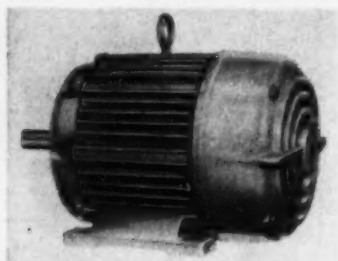
See our catalog in "Sweet's Product Design File" for information on the other Armco Special-Purpose Steels.

ARMCO STEEL CORPORATION

4903 CURTIS ST., MIDDLETOWN, O. • EXPORT: THE ARMCO INTERNATIONAL CORPORATION



NEW ELECTRICAL & MECHANICAL EQUIPMENT



New Electric Motors Are Smaller, More Powerful

Built in accordance with the new NEMA frame size standards the new LA line of electric motors will be offered in open drip-proof, totally-enclosed fan-cooled and explosion-proof enclosures in ratings up to 40 hp. at 3,600 rpm. Features of the new line include new modern styling, improved ventilation, greater protection, a new conduit box arrangement, new bearing construction, and more versatile mounting.

More power in a smaller unit results from use of larger lamination diameters and longer stacking with shorter coil ends. Better utilization of aerodynamic principles gives more efficient and effective ventilation.

Bearing construction has been improved over the previous satisfactory designs. Grease seals have been improved to prevent leakage along the motor shaft. Factory lubrication will last for years under normal usage without maintenance attention. Optional grease fittings can be supplied where desired.

A split conduit box separates into halves for easy electrical connection. A lead-identification spacer inside the conduit box provides permanent and positive identification of the various leads. A new alternate conduit arrangement for open drip-proof motors permits omission of the conduit box where the motor must be used in crowded quarters.

A new name plate design includes bearing sizes, service factor and NEMA design type in addition to data carried on former name plates.—*The Louis Allis Co., Milwaukee 7, Wis.*

Variable Speed Drive Offered in Two New Types

Positive infinitely-variable-speed P.I.V. drives now are available in two new types for 20 to 25 hp. application.

In addition to the basic H-6P.I.V. of 25-hp. capacity an HG-6 drive now can be supplied. This drive is furnished with a helical gear attachment for either a single reduction input or a single reduction output. The HGG-6 drive is furnished with both a single reduction input and single reduction output helical gear attachment.

Input gear reductions are available over a range from 1.93/1 to 5.82/1 maximum. Output gear reductions range from 1/1 to 6.3/1. Speed increasing gear sets also are readily available.

P.I.V. variable-speed drive provides accurate speed control adjustable over a wide range of speeds. It transmits power positively without slip. Speed ratio is changed by altering the effective diameters of the cone-shaped wheels.—*Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.*



Inert Pipe Thread Sealer Contains Teflon

A chemically inert pipe thread sealing compound is formulated with a base of Teflon. Known as Teffilm this compound forms a continuous film. It prevents spiral working, leakage and contamination of material being conveyed.

Properties of the Teflon provide leak-proof seals against fluids and gases under pressure. At the same time joints are easily broken when necessary without galling or shearing of threads. Thus expensive alloy fittings can be reused.

Two consistencies of Teffilm are offered—light bodied for precision threads and viscous for manual applications. Both are suitable for all chemicals to which Teflon is inert and for temperatures up to 400 deg. F.—*Eco Engineering Co., 12 New York Ave., Newark, N. J.*



New Mechanical Rectifier Has High Efficiency

A new mechanical rectifier unit substitution for providing d. c. power operates at better than 96 percent efficiency. This includes losses in transformers, switchgear and other associated equipment.

Rectifier has been tested under actual operating conditions for more than 2 years. It has proved very stable with long contact life. Improved mechanical design and bias circuits in the commutating reactors explain extended contact life.

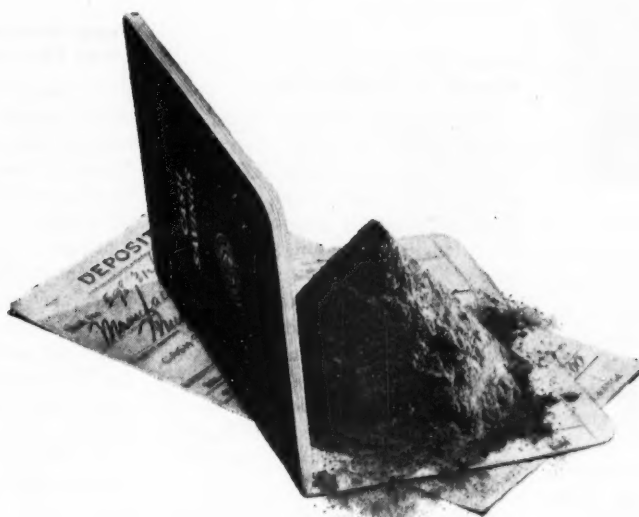
Mechanical rectifier units are available for providing up to 12,000 amp. at voltages up to about 250 v. d.c. Above this voltage units are rated usually for 6,000 amp. up to approximately 500 v. d.c.

Equipment is completely metal-enclosed for protection of operating personnel. Draw-out facilities permit easy inspection during maintenance periods.—*General Electric Co., Schenectady 5, N. Y.*

Glove Dryer Speeds Gloves Back to Service

Rubber gloves can be dried quickly through use of a new accessory for the Sani-Dri electric dryer. Two glove holders in the shape of hands attach to the air stream tubes. Twin streams of warm air dry the gloves quickly. There is no danger of burning or damage to the gloves.

Use of this device permits gloves to be washed and returned to service quickly. Unit can be used by food processors, chemical companies, drug manufacturers and laboratories.—*The Chicago Hardware & Foundry Co., North Chicago, Ill.*



For Immediate Deposit!

Buell Engineers have made an *exact* science of the recovery of valuable industrial dusts. With the help of Buell equipment, many of America's Leading Corporations make substantial cash savings every day.

Buell's specialized knowledge and experience make possible a scientifically accurate forecast of efficiency and economy before you spend a single penny. You see, Buell specialists study dust content and

operating conditions and submit a written report on effectiveness in advance.

We are always glad to supply the names of present users of Buell equipment right in your own field. Their year 'round experience is our best selling point!

Send for our informative Brochure—The Collection and Recovery of Industrial Dusts. It explains *all three* Buell systems of industrial dust collection. Write Dpt. 12-B, today for your complimentary copy. Buell Engineering Company, 70 Pine Street, New York 5, N. Y.

buell



20 Years of Engineered Efficiency in
DUST COLLECTION SYSTEMS

NEW SAFETY EQUIPMENT



Sure Footed Rubber Holds on Slippery Surfaces

Already in use by plane handlers on the decks of aircraft carriers this new safety rubber is now available for industrial use. The squeegee action of the concentric suction cups prevents slipping. Neoprene construction gives long life in the presence of oil, grease, acid, chemicals and solvents.

Rubber is molded in one piece with no fabric lining—weighs only 9 oz. Easy stretchability of the neoprene allows fitting of shoe sizes from 6 to 12 with only three rubber sizes—small, medium and large. It can be easily turned inside out for thorough washing.—Tingley Rubber Corp., 903 Rock St., Rahway, N. J.

First Aid Kit Designed for Quick Easy Use

New simplified fully-illustrated instructions together with easily accessible contents give a new type first aid kit maximum utility. When the lid of the blue metal kit is opened the unit packages inside extend above the base for quick removal. A rubber gasket between lid and base provides a tight seal against dust and moisture.

Each first aid item in the kit bears a control test number. This guarantees the user the same rigid inspection and control found in highest quality pharmaceutical products.

Included in the kit are visual swabs with tips of gauze rather than cotton. Gauze has no loose fibers to cling to the wound. Labels on antiseptic containers are printed in different colors to avoid confusion. Ammonia inhalant vials are covered with a special treated fabric that turns brown in case of leaks.

Compress bandages have 5 ft. tails of bleached muslin. This gives greater

strength, better holding and tying quality and neater appearance. Triangle bandages are sterilized so that they may be used on open wounds when necessary.—Mine Safety Appliances Co., 201 North Braddock Ave., Pittsburgh 8, Pa.

Pictorial Instructions Placed on Extinguisher

Foamite and soda-acid 2½-gal. fire extinguishers now carry pictorial operating instruction labels. Change in extinguisher labeling stems from a revision in the code imposed by regulatory bodies governing such practice.

Formerly, it was necessary to include recharging instructions on the extinguisher label. Revised rulings no longer require this. Instead, recharging instructions are placed on the recharge package. This makes available more space on the extinguisher for operating instructions.

Four action pictures demonstrate the sequence of steps to be followed in operating the extinguisher correctly. This will eliminate possible delay or confusion at the time of a fire, avoid the needless loss of fire

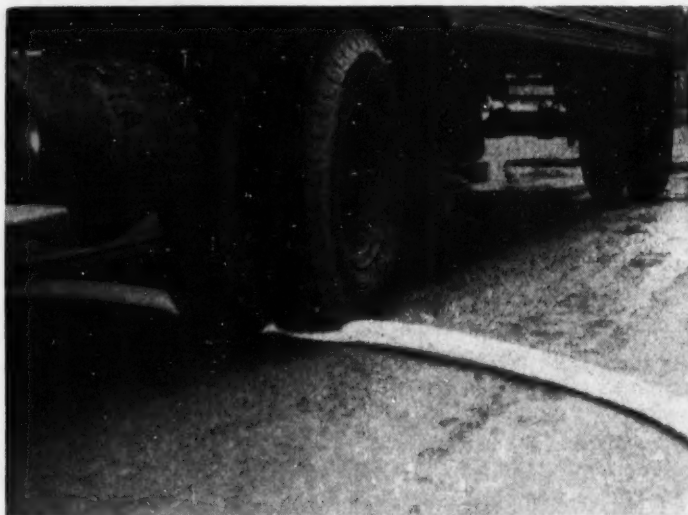
extinguishing chemical, and ensure that the hose shall be held correctly for proper application of the stream to the blaze.—American-La France-Foamite Corp.

Foam Proportioner Gives Three Way Protection

An inexpensive new foam proportioner permits delivery of water, wet water or foam with the turn of a valve. Either a thick blanket of foam may be generated or wet water may be supplied where quick, deep penetration is desired. At the same time where an ordinary fire is being fought plain water may be delivered.

Combination proportioner is light in weight and easily portable. It also can be permanently mounted on a fire truck. Inlet and discharge outlets are for ½-in. hose.

At 125 psi. or higher inlet pressure the proportioner will operate with a foam nozzle to produce 400 to 600 gpm. of mechanical foam. An equivalent capacity fog nozzle may be used when a wetting agent is required.—National Foam System, Inc., West Chester, Pa.



GLASS FIBER FIRE HOSE WITHSTANDS HEAVY SQUEEZE

Not once but many times was this glass fiber fire hose jolted by the passage of heavy trucks. Yet subsequent tests and X-ray examinations showed no damage to the hose. Compared to conventional cotton hose this newly developed glass fiber hose is 20 lb. lighter per 100 ft. length. The glass fiber carcass does not absorb water, thus stays much lighter and more flexible on the fire line. High strength of the glass fiber yarn permits a thinner wall construction and larger bore for handling more water flow.—Boston Woven Hose & Rubber Co., P. O. Box 1071, Boston 3, Mass.

Can you name these states?



There are Continental fibre drum plants in all of them



ANSWERS: 1. New York 2. Pennsylvania 3. Ohio 4. Missouri 5. California

No other company offers you the cross-continent, on-the-spot fibre drum service of Continental. With the opening of our giant new plant in Pittsburg, California, there are Continental manufacturing facilities within easy shipping distance, wherever you do business in the United States.

This easy availability is only part of the Continental service story. When you choose tough, lightweight Leverpak, Stapak, or Fiberpak drums, you have your choice of many sizes, 17 colors, any of 14 inks. Made-to-order linings are available to give your product extra protection. Continental's packaging engineers and research teams stand ready to help you test your shipping methods and to help solve your packaging problems.

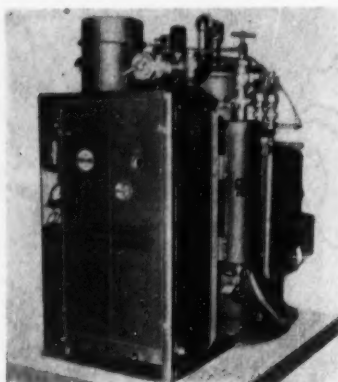
For safe shipment of your bulk products, you can't beat Continental fibre drums. For packaging advice, you can't beat Continental service. Why not call on us soon?

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NEW HEATING & COOLING EQUIPMENT



**Compact Steam Generator
Works on Gas or Oil**

Merely by flipping one switch you can convert the Model OKJ-4740 steam generator from oil to natural gas fuel.

The fuel-oil spray nozzle is mounted within the metal body of the gas furnace. When the fuel selection switch is flipped from natural gas to oil it releases oil under pressure through the spray nozzle. A constant spark and pilot light insure positive lighting.

Working steam pressure up to 300 psi. can be developed from cold water in less than 3 min. Generator makes 1,500 to 5,000 lb. of steam per hr.

Automatic controls modulate steam output to meet changing steam demands. Steam pressure may be changed from 10 to 300 psi. by turning one control.

Steam generator comes as a complete package. Included are a 7½-hp. electric motor, blower, feedwater pump, steam separator, steel coils and all controls. Over-all dimensions are 50 in. wide, 80 in. high and 73 in. long.—Vapor Heating Corp., 4501 West 16th St., Chicago 23, Ill.

Axial Blower Moves Hot Contaminated Air

Air at temperatures up to 350 deg. F. can be moved by the Vaneaxial blower without fear of damage. Also the unit handles air containing acids, alkalis or fine abrasive dust.

Blower is a modification of the standard belt-drive Vaneaxial blower. Guide vanes are contained in a special dummy section. The drive is located on the negative pressure side of the blower.

With this arrangement clean air from outside the ducts is drawn in

through the belt tube and over the bearings. On blowers of conventional design, leakage of destructive air from the air stream to the belt and bearings cannot be avoided.

Removal of all parts from contact with the air stream assures long life and trouble-free operations.

Blowers are available in a range of sizes from 12 to 54 in.—Hartzell Propeller Fan Co., Piquette, Ohio.

Ventilating Wheel Acts as Heat Exchanger

A wheel rotating in counterflowing air streams transfers heat from one to the other. By using the Therm-O-Wheel up to 96 percent of the heat or cold generally lost through ventilation is said to be recovered.

Heat transfer medium is metallic wool attached to the framework of the wheel.

Exhaust air is blown through the upper half of the Therm-O-Wheel and ducted out of the building. Heat in the exhaust air is transferred to the metal wool.

At the same time fresh, cool air is blown through the bottom half of the wheel. Heat previously transferred to the wool by the exhaust air now is picked up by the entering air.

On jobs where low temperatures must be maintained within the building the Therm-O-Wheel acts just as effectively to cool incoming air.—Therm-O-Wheel, Inc., 1042 22nd St., Far Rockaway, N. Y.

Rotating Steam Joint Has Longer Life, Costs Less

Lighter weight, smaller size, lower cost and longer life are claimed for the new Series 2000 type S self-supporting rotating steam joint. Design works well where suitable supports cannot be provided and where lateral movement exists. It is used for admitting steam or other fluids into the rotating rolls and cylinders of paper, textile, rubber and similar machines.

Joint is completely packless, requires no lubrication. It is self-adjusting to varying pressures. Longer life has been secured by increasing the effective thickness of the carbon graphite seal ring.

Units are available in a wide range of threaded nipple sizes for pressures

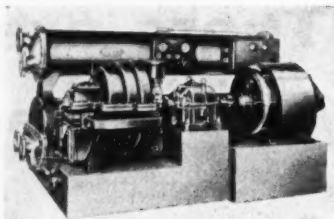
up to 150 or 250 psi. and for 450 deg. F max. Both flow and syphon pipe arrangements are offered.—The Johnson Corp., Three Rivers, Mich.

Plate-Type Coils Cost Less Than Pipe Coils

Thermo-Panel plate coils are said to be an effective substitute for pipe coils in tank heating and cooling. Use of these coils eliminates need for expensive pipe cooling. Also Thermo-Panel plate coils are used as radiant cooling panels around furnaces such as used in the manufacture of glass or steel.

Low cost and light weight are outstanding features of the Thermo-Panel plate coils. They are easily replaced and simple to clean.

Coils are available in special shapes and in a wide range of materials including stainless steel, monel and other special alloys.—Dean Products, Inc., 1042 Dean St., Brooklyn 38, N. Y.



Centrifugal Coolers Now Made in Smaller Sizes

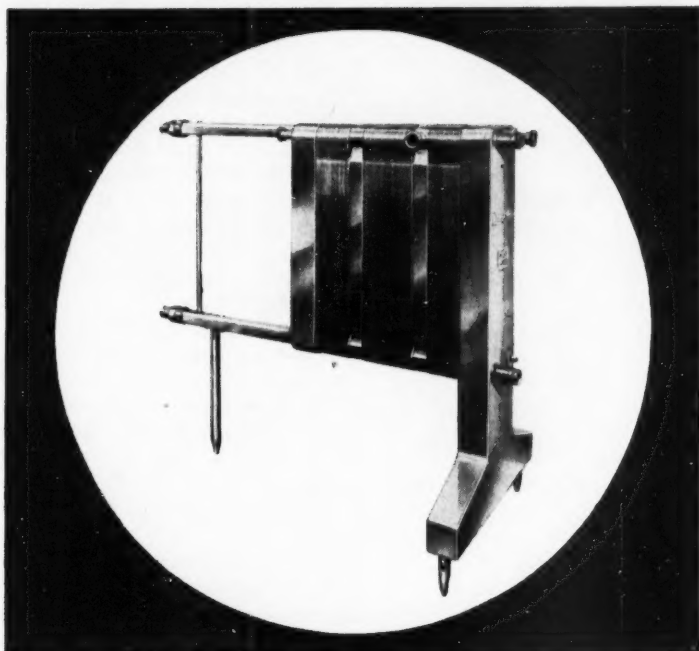
The Carrier line of centrifugal refrigerating machines now has been extended to include units from 75 to 200 tons. Advantages are similar to the larger sizes; long machine life at high efficiency, compactness, freedom from servicing problems and automatic response to variations in the cooling load.

In addition this machine is the only one in this size range which can be connected to any type of drive. It can be adapted to automatic constant speed with synchronous motors. This enables building or plant power factor correction to be furnished when desired.

Impeller wheels are made of lead-coated alloy steel. Separate cast iron water heads on both condenser and cooler permit easy access for inspection.—Carrier Corp., Carrier Bldg., Syracuse 1, N. Y.

Announcing!

THE DE LAVAL PLATE HEAT EXCHANGER



FOR HEATING, COOLING and REGENERATION

The De Laval Separator Company announces its newest product—the De Laval Plate Heat Exchanger. Behind the De Laval Plate Heat Exchanger are many years of experience and successful performance, for it has been sold by the thousands in Europe and Canada where it is known as the Alfa-Laval Plate Heat Exchanger.

Throughout industry there are many processes that require the use of the Plate Heat Exchanger. The De Laval Plate Heat Exchanger offers a high heat transmission coefficient, ease of dismantling and cleaning, plus maximum heat recovery.

Simple, rugged design based on the principle of enlargement, the unit can be rebuilt or extended, as required. This feature will be fully appreciated in modern plants where adaptability is a major asset.

For complete information, please write and give us the details of your heating or cooling problem.

FEATURES OF THE DE LAVAL PLATE HEAT EXCHANGER

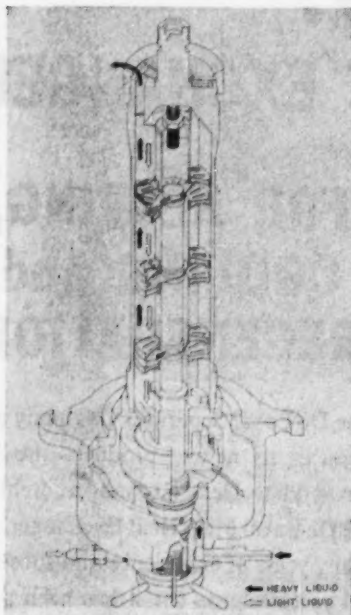
1. All heat-transmitting surfaces are accessible for inspection and cleaning.
2. Complies with sanitary requirements—designed for "in-place" cleaning.
3. Easy variation of assembly to meet changes in operation—plates are invertible (except Model P5).
4. Easy to assemble—special design for precision tightening—ball bearing tightening nuts with constant tension thrust washers.
5. Space requirements are small.
6. Unsurpassed heat transmission.
7. All parts which contact the liquid are made of highest quality acid-resisting stainless steel.
8. Heater, cooler and regenerative sections may be assembled in one unit.
9. Several liquids can be treated simultaneously in different sections of the same Heat Exchanger.
10. Liquid cannot leak from one section to another—liquid cannot become mixed with the heating or cooling medium.
11. Sturdy construction for high-pressure operation.
12. Gaskets are easily replaceable in the user's plant.
13. Highest quality instrumentation by Taylor Instrument Company.
14. Available in three sizes for a wide range of capacities.

De Laval PLATE HEAT EXCHANGERS

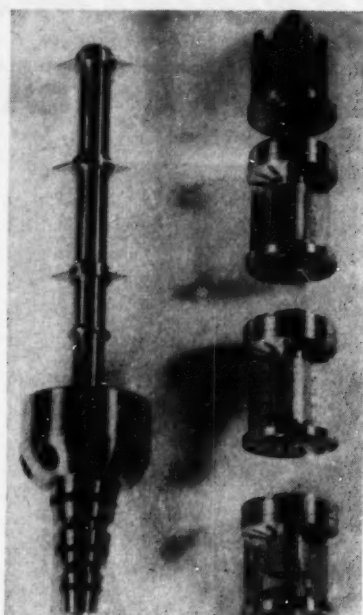
THE DE LAVAL SEPARATOR COMPANY • Poughkeepsie, New York • 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5



NEW PROCESSING EQUIPMENT



BOWL and chambers rotate about shaft.



SHAFT and chambers removed from bowl.

Inside a Spinning Tube . . .

. . . Immiscible liquids are alternately intermingled and separated. Flow is countercurrent with choice of 1 to 5 extraction stages within one centrifugal contactor.

Taking advantage of long-time working partnership with centrifugal force, Sharples Corporation Research Laboratories now has come up with a new liquid-liquid contactor. Tagged the Super-Centactor this new centrifugal machine is expected to find ready application in liquid-liquid extraction, particularly in the pharmaceutical and petroleum industries.

First model available can handle a total liquid throughput of 80 gph. From 1 to 5 extraction stages can be used yet the total working volume inside the tubular bowl measures only 8 in. long by 1½ in. I.D.

Development work is well along on a larger unit to have a bowl I.D. of at least 4 in.

Stage efficiency varies with throughput. In many systems an optimum flow exists where 100 percent stage efficiency can be obtained. Volumetric flow ratios between phases can be varied with little effect upon Centactor operation.

Operation-wise the Super-Centac-

tor leaves little to be desired. Operating speed is reached in about 1 sec. Once the feed is started only the flow rates need to be monitored; all other factors are automatically fixed by the manner in which the bowl was assembled initially. Complete disassembly, modification, cleaning and reassembly can be done in less than 5 minutes.

There are no rotating seals. Only 2 inexpensive gaskets require occasional replacement. No lubricated bearings are ever in contact with fluids being processed.

Extraction assembly consists essentially of a cylindrical, vertical shaft which remains stationary and a concentrically mounted tubular bowl that rotates around the shaft.

The shaft contains passages for delivery of fluids to the rotating bowl. Also short triangular blades mounted on the shaft agitate the liquids in the revolving bowl.

Within the bowl are alternate mixing and settling chambers. Each of

the mixing chambers rotates around a mixing blade on the stationary center shaft. There are adjustable baffles on top and bottom of each mixing chamber. Settling chambers are distinguished by three accelerating vanes or wings.

Both heavy and light liquid enter through the bottom of the machine. Light liquid rises through a passage in the stationary shaft to the top mixing chamber; heavy liquid enters the bottom mixing chamber through another passage. Ring-dam levels at top and bottom of the bowl are adjusted so that heavy liquid flows upward and light liquid flows downward to the discharge points.

Consider for a moment what happens to heavy liquid entering the bottom mixing section. It meets light liquid moving down the bowl and entering through the top baffles. As the two liquids surge at high speed around the mixer blade they are so closely intermingled that an emulsion forms.

The mixture then flows through both top and bottom baffles out of the mixing zone into the separating zones. Baffle openings are adjustable from 1/64 to 4/64 in. Viscous shear working on the mixture passing through the baffles helps to break the emulsion and bring the fluids back up to the bowl speed. These baffles also prevent charging or short circuiting of material from inlet to outlet.

Accelerator vanes complete speed-up of the liquids to obtain final separation. While there is some recirculation around each mixing zone there is a net flow of heavy liquid upward and light liquid downward.

Machine flexibility is sufficient to meet individual extraction needs. Location and number of mixing blades on the stationary shaft is determined by spacer collars. Blades and spacers are locked together in one immovable unit by a nut at the top of the shaft.

Mixing and separating assemblies can be varied in number to coincide with any changes in the location of the mixer blades.

Rotational speed of the bowl can be varied from 5,000 to 25,000 rpm. Over this range of speeds centrifugal force at the bowl wall will vary from 620g. to 15,500g.

For standard operation the Super-Centactor runs at atmospheric pres-

RESEARCH KEEPS

B.F. Goodrich

FIRST IN RUBBER



That white stuff winds up as windows

A typical example of B. F. Goodrich improvement in rubber

THAT steaming white cargo riding the conveyor belt is a special kind of salt, used in making window glass for the nation's stores, factories and homes.

As the salt travels from ovens to storage tanks, it is often 400 degrees hot. And with 1000 sizzling tons to move every day, expensive asbestos belts were burning out in seven months.

Then the company heard that B. F. Goodrich had developed a special heat-resisting rubber for belts that carry such hot materials as coke and

lime. Inside the belt, B. F. Goodrich uses a rayon fabric that not only stands up under heat, but also makes a thinner, more flexible belt.

Put to work here at just half the cost of the asbestos belt it replaced, the B. F. Goodrich belt had lasted 50% longer when this picture was taken. Yet it still went on working until it reached the record of twice as much service.

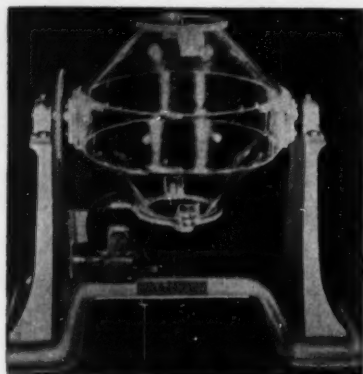
Making a belt to stand terrific heat is typical of improvements made in other B. F. Goodrich belts—belts to carry materials that tear and cut ordi-

nary rubber, stand crashing blows of dropping coal and rock, carry oily foods and grains, move packages uphill and down. B. F. Goodrich research constantly improves them all. That's why it will pay you to find out what recent improvements B. F. Goodrich has made in any rubber product you use. Call your local BFG distributor, or write *The B. F. Goodrich Company, Dept. M-147, Akron 18, Ohio.*

B.F. Goodrich
INDUSTRIAL PRODUCTS
DIVISION

NEW PROCESSING EQUIPMENT

sure. Low feed pressure can be used with gravity feed satisfactory for low feed rates. Where needed the equipment can be furnished for operation under pressure.—**Sharples Corp., Research Laboratories, Bridgeport, Pa.**



**Laboratory Dry Blender
Is Answer to Peeping Toms**

You don't need X-ray eyes to see what's going on inside this laboratory blender. The clear, rigid plastic cone gives full visibility of the entire operation.

Now you can observe the effects of changes in blending times, changes in consistency of raw materials, density differences, size and shape of particles as well as adherence of particles to each other or the blender walls, particle breakage, etc.

Blender has a gross capacity of 0.5 cu. ft. and a batch or working capacity of 0.31 cu. ft. It can blend any materials weighing up to 100 lb. per cu. ft.—**The Patterson Foundry & Machine Co., East Liverpool, Ohio.**

Nitrogen Generator Operates at Lower Cost

Cost of producing nitrogen has been markedly reduced through redesign of the Nitroenal gas generator. Both installation and operating costs now are lower.

A new heat exchanger lowers the gas dew point from 75 to 40 deg. F. This permits use of smaller, less expensive dryers that are cheaper to operate.

The Nitroenal generator produces pure nitrogen with a controllable hydrogen content. Ammonia reacted with air in the presence of a precious metal catalyst gives a nitrogen, hydro-

gen, water vapor mixture completely free of oxygen. Hydrogen content can be varied between 0.25 and 25 percent.

Generator is fully automatic and completely free of explosion hazards. The precious metal catalyst is characterized by long life.—**Baker & Co., Newark 5, N. J.**

Paper Stock-Chest Feeder Reduces Hang-Up of Solids

A common difficulty with paper stock-chests is the tendency of stock to stick or hang to the sides of the chest. Inlet point usually is in the center of top directly above the bottom outlet. Incoming stock piles up under the inlet. The increased weight at this point causes stock to move to the discharge only through the central section of the chest.

With little or no movement down along the side walls stock tends to stick, dry out and eventually break loose as a contaminating material.

Use of a Side-Flo feeder mechanism at the inlet is said to greatly reduce this problem. A motor driven impeller throws the stock to the outer chest walls. With the extra weight added at this point discharge flow pulls stock from the entire cross-sectional area of the chest.—**Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.**

Dispersion Mixers For High Intensity Jobs

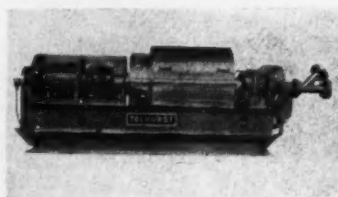
Two new drive units have been added to the Dispersator line of high intensity mixers. Units are designed to operate in the 30 to 300-gal. batch range.

Series 2400 is designed for beam or channel mounting with open tanks; Series 3200 is for flange-mounting sealed-system operations.

In the 250 cps. range these mixers will handle from 100 to 600 gal. Where materials have viscosities in the 1,000 cps. range the units will handle 50 to 250 gal. For viscosities of 5,000 cps. intensive mixing may be obtained in batches from 15 to 100 gal.

Dispersators operate with flexible motor couplings, sealed for life bearings and sturdily welded or cast support frames. In the 2400 unit the driven shaft is readily demountable by loosening the chucks. The 3200

driven shaft is fixed since alignment at a mechanical seal is often required.—**Premier Mill Corp., Geneva, N. Y.**



Continuous Centrifugal Has Operating Flexibility

Latest entry in the field of continuous centrifugals is the Maxiflex machine. Design effort has been centered on producing a machine with maximum operating flexibility.

For short runs on different products it is possible to clean out the machine and readjust variables in minimum time. On long runs the built-in flexibility permits making adjustments, without lost time, to compensate for upstream changes.

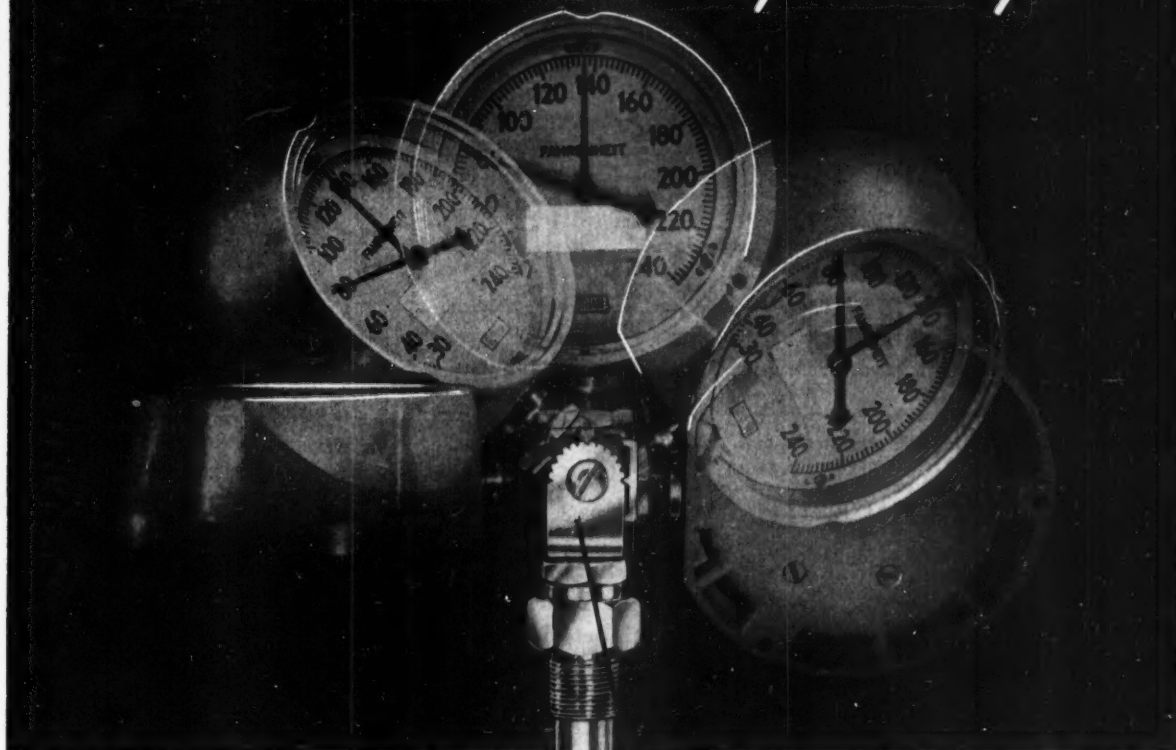
Foremost feature is a hydraulic-mechanical device that permits instantaneous selection of the optimum differential speed between the conveyor screw and the separating bowl. Orifice plates are adjustable for a range of 7 different pool depths. Speed is variable up to a maximum centrifugal force of 2,000 times gravity. Feed chambers are said to be self-cleaning.

Machines are available in sizes of 18 by 28 and 24 by 38 in. bowl dimensions. A limited number of units are available for 90 day plant trials.—**Tolhurst Centrifugals Div., American Machine & Metals, Inc., East Moline, Ill.**

Heavy-duty mixer for wet and dry materials is available both in 1- and 1½-ton sizes. Continuous scooping and sweeping action within the mixer assures high uniformity from batch to batch.—**Rapids Machinery Co., Marion, Iowa.**

Raschig rings and perforated disks for packing supports now are fabricated of Kel-F. Plates are available in thicknesses up to 1 in. and over. Hole sizes and perforation patterns can be varied to meet individual requirements.—**United States Gasket Co., 608 North 10th St., Camden, N. J.**

Any way you look at it this Thermometer is *Easy Reading*



You've been asking for a dial thermometer like this—A thermometer that can be positioned and firmly locked at any practical angle—now you can have it!

No stretching or straining to see this thermometer. Easy to adjust to required new positions before or after installation. No risk of the multi-angle selector working loose. A specially designed selector assures positive locking at every practical mounting angle and a few turns of *one* nut lock the selector securely.

These instruments, supplementing USG's complete line of Gotham temperature indicators, are designed to fit all standard connections and are available in all standard ranges. If you have a number of applications requiring "odd angle" mounting these new multi-angle thermometers will reduce the number and variety of instruments you have to carry in stock.

Before you order an angle thermometer be sure you see USG's new Gotham Multi-Angle Thermometer.

USG

UNITED STATES GAUGE

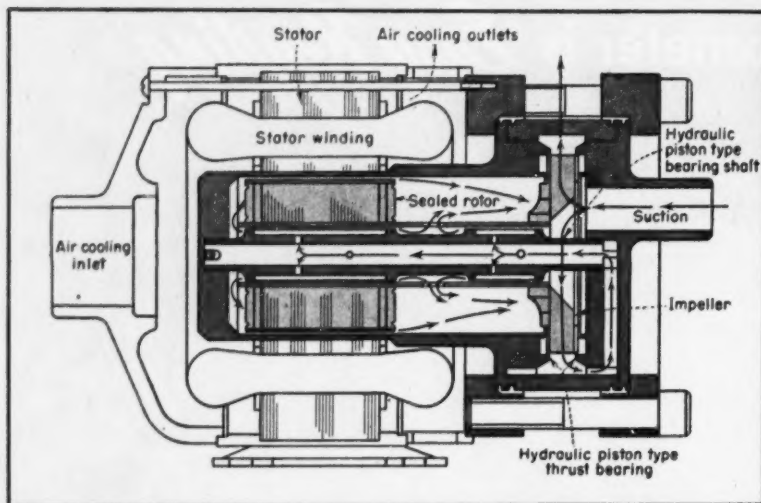
ADVANTAGES

1. Positive locking in every conceivable angle.
2. Reduces the number and variety of instruments required in your maintenance stock.
3. Provides that extra "odd angle" instrument which normal stock does not furnish.
4. Easy to change to any desired angle, before or after installation.
5. Saves engineers time when writing specifications.
6. Affords easy reading at odd angles.

Dept. 3
United States Gauge
Division of American Machine and Metals, Inc.
Sellersville, Pa.

Gentlemen:
We'd like to know more about the new USG Multi-angle Thermometer. Please get in touch with us.

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____



FLUID BLEED from impeller circulates through fluid-piston shaft bearings.

Fluid Bearings on Sealed Pump

To take full advantage of hermetically sealed pump one maker has evolved a new fluid bearing. Bearing metal is same as pump body; fluid pressure supports load.

An entirely new strategic concept has been gaining impetus among process pump manufacturers. It eliminates completely the problem of securing a liquid-tight seal against a moving surface.

A pump design, recently disclosed by E. F. Brill, Chief Engineer, Nuclear Power Section, Allis-Chalmers, shows where this type of thinking is leading. All moving parts of the pump and driver are hermetically sealed within the fluid system.

Development of this idea led to tandem mounting of a canned induction motor and the pump impeller on a common shaft inside a closed vessel. Of necessity the shaft bearings had to be wet by the system fluid. And for the pump to have the widest possible use the bearings had to be constructed of the same material or metal as the pump parts themselves.

With these conditions in mind Allis-Chalmers' engineers developed a fluid piston type bearing. Self-compensating fluid pockets are used to center and support the rotating elements free and clear of any bearing metal surfaces.

Rotating common shaft carrying

impeller and motor rotor actually is a hollow tube. Inside the tube is a concentric, stationary, hollow, bearing shaft.

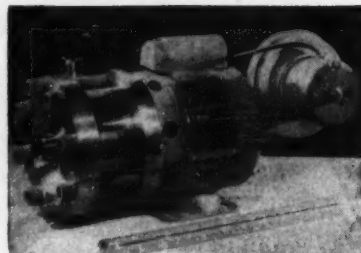
Three or more equally spaced bearing pockets are milled on the surface of the stationary shaft. An orifice hole connects each bearing pocket to the hollow center passage of the shaft.

If fluid being pumped under pressure is supplied through the shaft passage to the bearing pocket then the tube will float and rotate concentric with the stationary shaft. Since pressure is equal in all pockets the radial forces on the internal wall of the tube are equal at all points.

Any movement of the tube away from the concentric position produces unequal radial pressures. The net result is that the tube is recentered.

If the tube moves off center, flow into one pocket is restricted while the pocket on the opposite side receives a greater flow. Pressure builds up in the restricted pocket and decreases in the opposite pocket. The resultant force acts to push the tube away from the restricted pocket.

On start-up there is a rubbing metallic contact for the first few revo-



SEALED pump for 2,000 psi. system.

lutions until some fluid pressure is built up. While this rubbing would ruin film-type bearings it actually has no detrimental effect on the performance of the fluid-piston bearing. During normal operation there is no change of clearance or wear in the bearings since there is no metal-to-metal contact.

A non-magnetic barrier seal in the form of a shell encases the motor rotor mounted on the rotating tube. This shell is welded to the pump casing providing an hermetic seal.

Stator windings of the motor are mounted externally on the shell. In this position they can be replaced readily without exposing the fluid to loss or contamination.

Space between the shell and rotor, corresponding to the air gap of a conventional motor, is filled with circulating fluid. Cooling of the rotor and stator is attained thereby. In addition, the stator windings are cooled either by circulation of water or air.

These pumps are available in two general types: the general purpose unit for fluid temperatures of 1,000 deg. F. or less and the multi-purpose unit for temperatures up to 1,500 deg. F.

On the general purpose type, bearing fluid is taken directly from the volute of the pump impeller. After passing through the bearings it travels back around the motor rotor into the main fluid system. With such an arrangement heat removed from the rotor is carried into the fluid system.

The multi-purpose pump has a separate fluid system for pressurizing the bearings and cooling the rotor. An auxiliary impeller circulates the bearing fluid and a heat barrier separates it from the main fluid system. Thus the fluid surrounding the rotor can be held below the temperature of the main fluid system.

Life of these pumps depends largely

ALL OVER THE PLANT... YOUR PLANT!

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WILL SAVE MONEY,
MAKE MONEY
FOR YOU!

LIQUID DELIVERY CONTROL

COST CONTROL

DEPARTMENTAL CONTROL

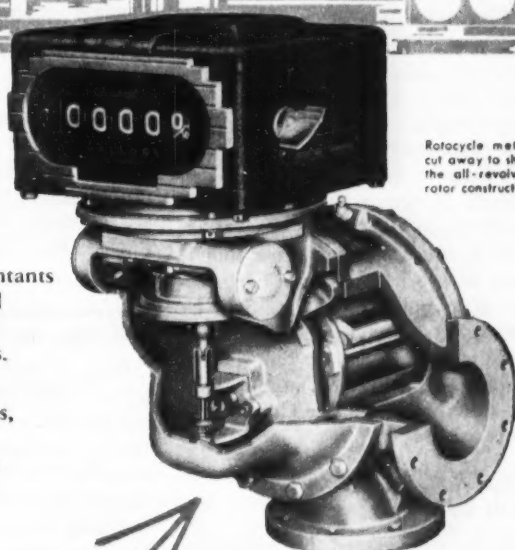
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LIQUID FUEL CONTROL

PRODUCT QUALITY CONTROL

Wherever valuable liquids are stored, mixed or consumed, you will be way ahead to measure them with Rockwell industrial meters. They provide accurate records to verify your purchases, to stop losses. They guard the quality of your formulations when blending, mixing, batching. Your accountants will welcome meter records for cost control and tax analysis purposes. These same records will enable you to keep tab on all liquid inventories. There is a size and type of Rockwell meter to measure most any liquid that can be piped—oils, chemicals, paints, liquors, solvents, etc.—even corrosive fluids. Automatic shut-off valves and remote registration systems are available. For full facts use the handy coupon or write for bulletins.



Rotocycle meter, cut away to show the all-revolving rotor construction.

NOW A STAINLESS STEEL METER FOR MEASURING CORROSIVE LIQUIDS

This Rockwell Model 2-BC meter is constructed inside and out of stainless steel. It resists corrosion. Rated capacity 100 gpm. This is an ideal meter for measuring liquids entering into foods and pharmaceuticals—also chemicals and corrosive liquors. Write for bulletin OG-403.

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Pittsburgh 8, Pennsylvania

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Gentlemen:

I am interested in measuring _____ (Name of Liquid)

Pipe Size _____

Working Pressure _____ psi. Temperature _____ °F max.

Max. Flow Rate _____ gpm. Min. Flow Rate _____ gpm.

YOUR NAME _____

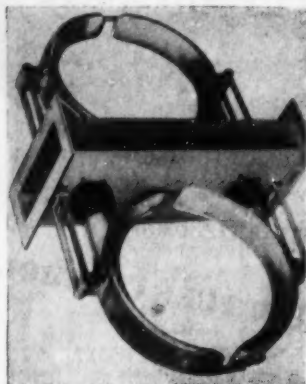
COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

NEW FLUIDS HANDLING EQUIPMENT

upon the operating temperature. At present more data are required before accurate predications of life can be made.—Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.



Dust Tube Blow Rings Are Self Adjusting

Type AC reverse-jet dust filters now are fitted with blow rings that automatically adjust themselves to individual filter tube contours. Perfect ring to cloth contact is assured, it is said. Compensation is automatic for variations in the felt tubes due to changes in temperature, pressure or moisture conditions.

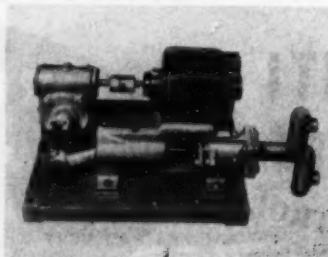
Each cast aluminum blow ring is made in two half sections. Each section is mounted on the air duct by two cast aluminum arms with roller chain linkage. Rings are furnished in multiples of 4 up to 32, in one cleaning assembly.—The Day Co., Minneapolis 13, Minn.

Diaphragm Pump Built as Packaged Unit

Advantages offered by diaphragm pumps are highlighted in a new simplified design offered as a packaged unit. Pump, two pole automatic pressure switch, motor and belt drive are all mounted on a rugged steel base.

Combination vacuum and pressure chambers provide a cushion for the incoming and outgoing fluid. Operating noise level is thereby reduced.

Simple construction of pump makes it easy to disassemble quickly without need for special tools. Unit can be furnished for capacities of 250, 350 and 450 gph. for total suction lifts to 25 ft.—W. S. Rockwell Co., 200 Eliot St., Fairfield, Conn.



Proportioning Pump Has Inexpensive Wet End

Unusual economy in operation and maintenance are claimed for the Little Giant proportioning pump. Unit is designed for water softening, boiler treatment, and all chemical applications up to 800 psi.

A new ball and seat design features efficiency and economy. Suction and discharge sides consist of integral ball and seat units. These units are easily removed with a large standard screwdriver. Replacement makes a practically new liquid end at low cost.

Reproducible stroke adjustment by the Manajust covers a range from 0 to 100 percent of rated capacity. A separate gear reducer is standard, allowing use of readily available standard motors for replacement.—Orchem Pump Div., Orlich Bros. Machine Works.

Valve-in-Head Compressors Are Easy to Service

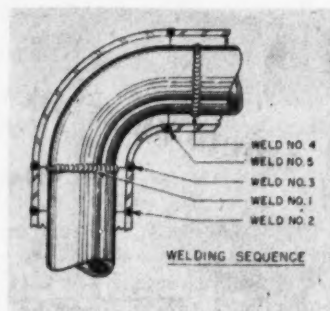
Ease of servicing and better cooling are claimed for Class ATH air and gas compressors. These machines employ sectionalized cylinders arranged in three pieces. Inlet and discharge valves are located in the front and back heads. Cylinder liners are furnished as standard.

Since the cylinder is sectionalized and readily disassembled the liner may be removed speedily. It is not necessary to disconnect inlet and discharge air piping.

This means any service problem involving piston rings, pistons or liners resolves into a minor operation. Likewise cooling water passages may be cleaned thoroughly with ease.

Valve-in-head construction allows better cooling and provides lower temperature throughout the cylinder and valves. Still further improvement is provided by cross flow of the cooling water.

Class 3-ATH compressors are available in single stage 100 psig. discharge pressure sizes at this time.—Pennsylvania Pump and Compressor Co., Easton, Pa.



Welding Sequence For Jacketed Pipe Turns

A simple and relatively easy procedure has been developed to employ welding fittings for directional changes in jacketed piping systems.

Jacketed fitting combination consists of long and short radius 90 deg. Tube-Turn elbows. On one end of the inside elbow is a tangent that extends beyond the corresponding end of the outside elbow. A short piece of pipe is attached to the inside elbow to facilitate installation work. Welding sequence, shown in the drawing above, must be followed exactly.

Advantages offered by this type of installation are (1) elimination of the need for steam or coolant jumpers; (2) elimination of flanged joints except where piping must be disassembled; (3) more accurate temperature control; (4) minimizes thermal expansion and contraction problems; (5) provides optimum flow conditions; (6) permits insulation to be readily and permanently applied — Tube Turns, Inc., 224 Broadway, Louisville 1, Ky.

Reagent Feeder Fabricated of Rigid PVC

For service on a wide range of corrosive chemicals the Model E reagent feeder now is available with unplasticized polyvinyl-chloride construction. This material provides higher resistance to the corrosive effects of sulfuric, hydrochloric and nitric acids, copper sulfate, ferric chloride and many other chemicals.

Ability to withstand corrosion plus

You'll save time and trouble on H.P. VESSEL GASKETS



**...when J-M Goetze gasket specialists
make them for you**

When you need gaskets such as those above, which were made for pressure vessel service over 5000 psi, consider this. It takes less time and trouble to turn the job over to J-M Goetze—an organization that has specialized in gasket design and manufacture for 67 years. And it usually costs less in the long run.

Goetze engineers can select the right style for maximum sealing efficiency. They know the correct metals and other factors required for efficient, long-lasting gaskets.

Goetze Gaskets are made exactly to the last detail of your specifications and conditions. They are made to craftsmen's perfection . . . with modern machine tools, some of which were specially designed by Goetze for gasket manufacture.

If you need gaskets for high pressure vessels or similar applications, send us a drawing or template for quotation. Or write for further information to Johns-Manville, Box 60, New York 16, New York.

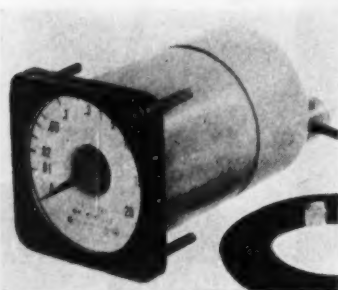


Johns-Manville *Goetze* GASKETS

**THERE'S A JOHNS-MANVILLE PACKING
AND GASKET FOR EVERY SERVICE**

NEW FLUIDS HANDLING EQUIPMENT

low initial cost make this an economical unit, it is said. Performance is comparable in all respects to the Model E reagent feeder previously available in other materials of construction.—*The Clarkson Co., 41 Sutter St., San Francisco, Calif.*



Molecular Vacuum Gage Comes as Integral Unit

Detectors and gage are combined in a common housing in a new molecular vacuum gage. Instrument is designed for panel mounting and connection to vacuum system by suitable piping. It covers the range from 0 to 20 mm. of dry air.

Operating principle of the gage is based on the rate of transfer of momentum energy from a moving surface to another adjacent and parallel surface. At low pressure this transfer rate is directly proportional to the gas pressure and the velocity of the moving surface.

The moving surface in the molecular vacuum gage is a rotating vaned cylinder moving at a constant speed of 3,600 rpm. This moving surface is aligned coaxially with a spring-restrained vaned cylinder. Distance between cylinders is $\frac{1}{8}$ in.

Gas molecules coming in contact with the rotating cylinder are set in motion in the direction of rotation. The gas molecules then strike the restrained cylinder, transferring energy to it. In turn the restrained cylinder moves a distance proportional to the amount of energy transferred.

The transfer of energy is a measure of the number of gas molecules present and, therefore, of the gas pressure. The scale pointer attached to the restrained cylinder indicates gas pressure directly on the scale.

Instrument is available in two types which are identical except for scale marking. One is calibrated directly for

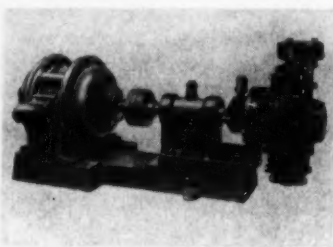
dry air. The other has a linear scale for use where individual calibration is preferred.—*General Electric Co., Schenectady 5, N. Y.*

Centrifugal Pump Has Molded Rubber Liner

Designed for operation without sealing water the Centriseal pump is particularly suited for pumping abrasive or corrosive slurries.

All pumping parts are protected by molded Maximax rubber. Rubber liners are molded to shape and mechanically locked into position.

For pumping acids the stuffing box packing gland and shaft sleeve are made of properly resistant alloys. Mechanical parts of the Centriseal pump are interchangeable with those of the anti-friction bearing type of Hydroseal pumps. — *The Allen-Sherman-Hoff Pump Co., 259 East Lancaster Ave., Wynnewood, Pa.*



Fluids Handling Equipment Constructed of Hard Rubber

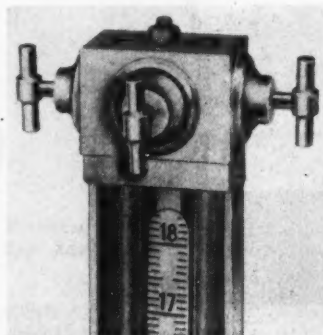
A line of corrosion resistant equipment including centrifugal pumps, valves, pipe and fittings now are manufactured in both natural and Buna N hard rubber.

Pumps are available either with a heavy casing and open impeller or lighter construction with a closed impeller. A carbon seal is used in place of conventional packing. This permits complete protective rubber covering of the metal shaft. Pump capacities range from 15 to 100 gpm. with discharge heads up to 90 ft. of water.

Globe, angle and Y-valves are furnished in sizes from 1 to 4 in. For maximum strength all stems and disks are metal reinforced. Disks with soft rubber seating surfaces are renewable.

Pipe and pipe fittings in sizes from $\frac{1}{4}$ to 4 in. are available in natural rubber, Buna N and special compounds. Design pressure is 50 psi.

Although natural hard-rubber compounds generally are not used above 120 deg. F. there are special compounds available for use up to 180 deg. F. The Buna N hard rubbers may be used up to 225 deg. F.—*Vanton Pump & Equipment Corp., Empire State Building, New York 1, N. Y.*



Three Valve Manifold Saves Space and Material

Two shut-off valves and one bypass valve in the Demi-34, provide a compact, rugged and tamper-proof valve manifold. Manifold arrangement is said to conserve space and material. Compared to three separate valves and fittings it reduces the number of connections from 12 to 2.

Manifold is provided with four connections. In the Manometer application shown only two-pipe connections are required. The other two are sealed between the Manifold body and the Manometer glass tubes.

Demi-34 body is available in brass, anodized aluminum, steel or stainless steel. All units have stainless steel diaphragms and integral seats. — *G. W. Dahl Co., Bristol, R. I.*

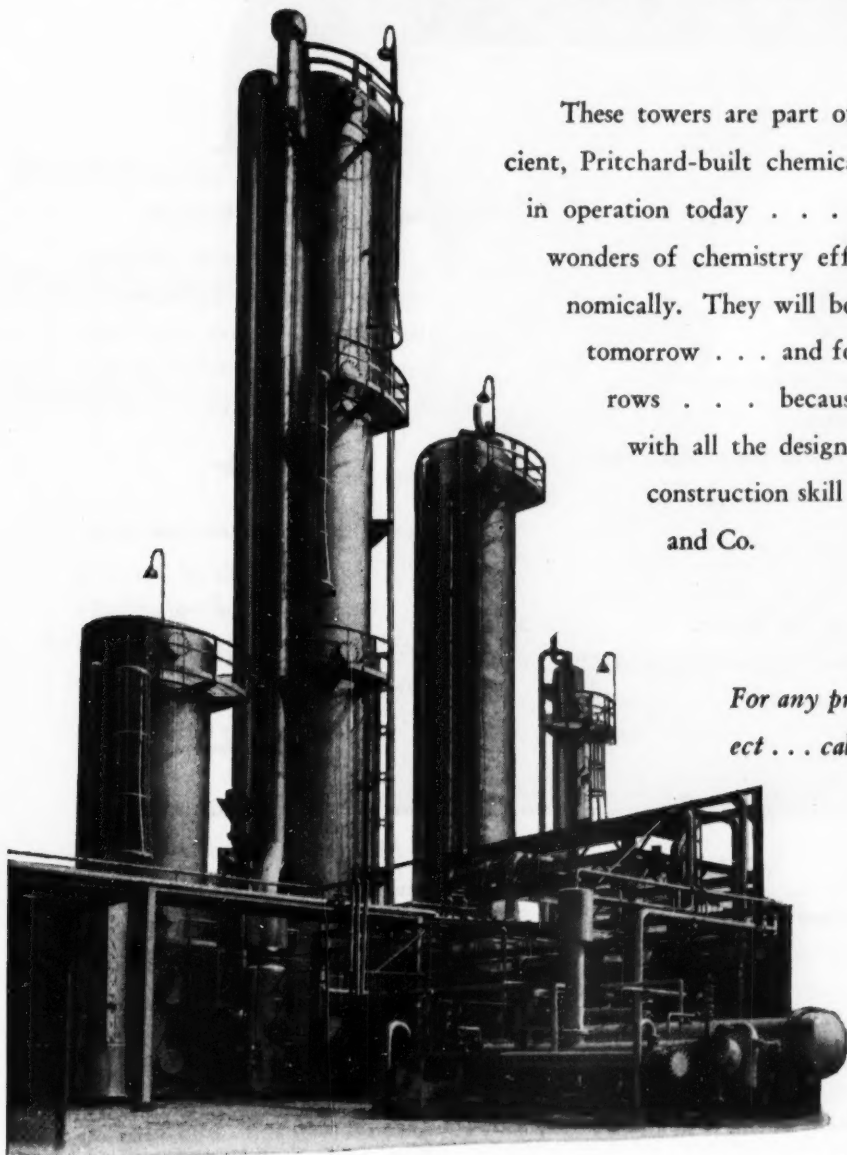
Self-Priming Plastic Pump Is Inexpensive and Long Lived

Offering low cost and long life a new series of plastic pumps is being offered with $\frac{3}{8}$ in. port sizes. The only moving part is an acid resistant neoprene impeller.

Pump weighs only 8 oz. and delivers up to 350 gph. at 10 ft. head and 1,750 rpm. Identified as Model 3010 it is offered with choice of corrosion resistant shafts.—*Jabsco Pump Co., 2031 North Lincoln St., Burbank, Calif.*

—End

TOWERS FOR TODAY AND TOMORROW



These towers are part of a modern, efficient, Pritchard-built chemical plant. They're in operation today . . . turning out the wonders of chemistry efficiently and economically. They will be producing more tomorrow . . . and for years of tomorrows . . . because they were built with all the design, engineering and construction skill of J. F. Pritchard and Co.

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GUIDED TOUR CONTINUED



PICTURED FLOWSHEET

- Polyvinyl butyral** 346

CHEMICAL ECONOMICS

- Government statistics can help you** 353
Highlight of the month 363
Trends in chemical prices and consumption . . 364
Equipment cost indexes 364

NAMES IN THE NEWS

- Names that made news last month** 366
Barnett F. Dodge, new vice president of AIChE . 374

LETTERS: PRO & CON

- Tower of Pisa?** 378

WHAT'S HAPPENING

- More news of what's been going on** 384
Little Boner 393

TECHNICAL BOOKSHELF

- Three newcomers for your reference shelves** . . 394
Your checklist of recent books & pamphlets . . 398

FIRMS IN THE NEWS

- Who's doing what among your suppliers** 402

READER SERVICE


- You can get more information—free** 460

TECHNICAL LITERATURE

- New literature from the manufacturers** 464


Make polyvinyl butyral.

Shawinigan Resins polymerizes vinyl acetate, hydrolyzes to the alcohol, reacts this with butyraldehyde. Here's how they do it. (*Flowsheet*)




Government figures can help.

There's a wealth of statistics in Washington on practically anything and everything. Here's how to tap them. (*Economics*)




Barney Dodge, the man

AIChE's new vice president is now in Spain "spreading the gospel of chemical engineering"—in Spanish. He's Barney Dodge: engineer, teacher, linguist, traveler. (*Man-of-Month*)



New technical literature . . .

You can now get—free and fast—literature on any subject in your field. Use our new, enlarged section to keep your files up-to-date. (*Reader Service*)

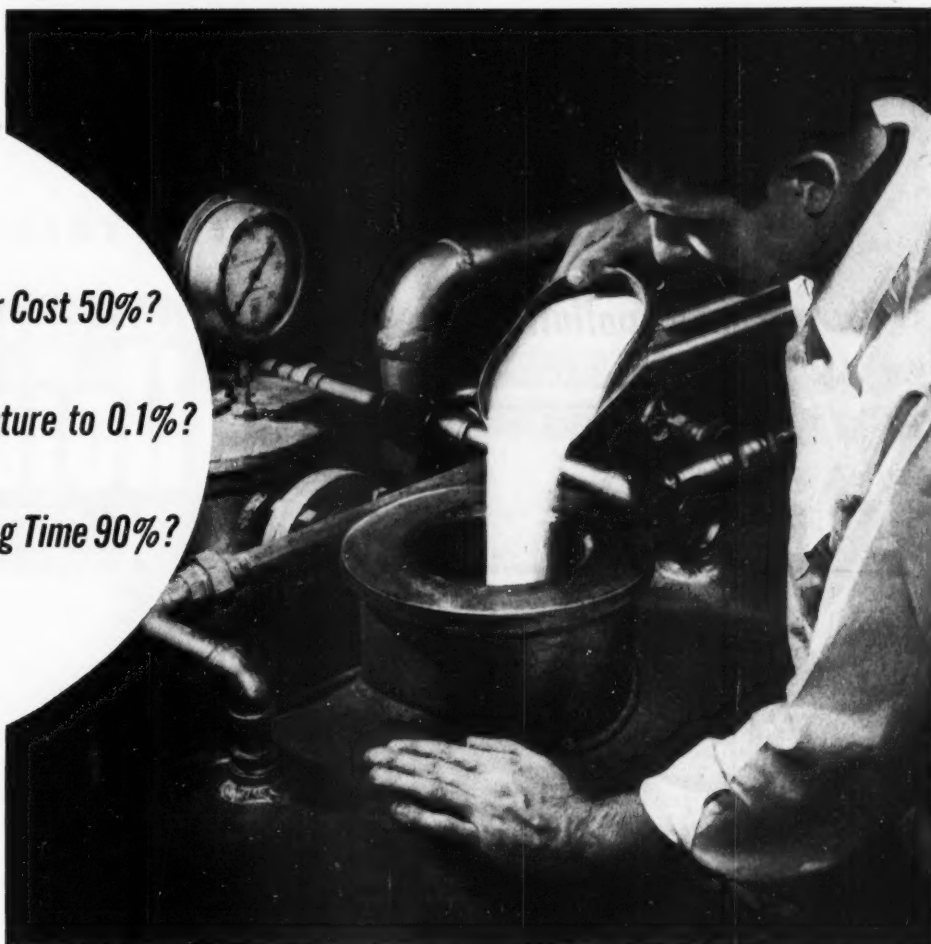


AND—Index of Advertisers precedes the Reader Service section.

What Cuts Labor Cost 50%?

What Cuts Moisture to 0.1%?

What Cuts Drying Time 90%?



Operator loads Rotary Vacuum Dryer in Stokes pilot plant.

Labor and time are reduced 50% by vacuum drying of a mixture of acetyl salicylic acid and other chemicals.

Sodium trichloroacetate is reduced from 35% to 0.1% moisture content in 8 to 12 hours by vacuum drying.

Several makers of powdered aluminum and brass avert fire and explosion hazards by drying powders and solvents in vacuum . . . then recover 99% or more of the solvent in the same process.

Shellac is dried in vacuum in 6 to 8 hours per batch, a job that formerly took 72 hours!

Stokes has the laboratory and pilot plant facilities to test vacuum drying of any product which offers drying difficulties. Methods, cycles, equipment, costs will be accurately determined. Stokes has 40 years' experience in vacuum technology to share with you on drying problems.

Send for an informative brochure, "Vacuum Drying," on the techniques of moisture removal from chemicals, pharmaceuticals and other industrial products.

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PHILADELPHIA 20, PA.

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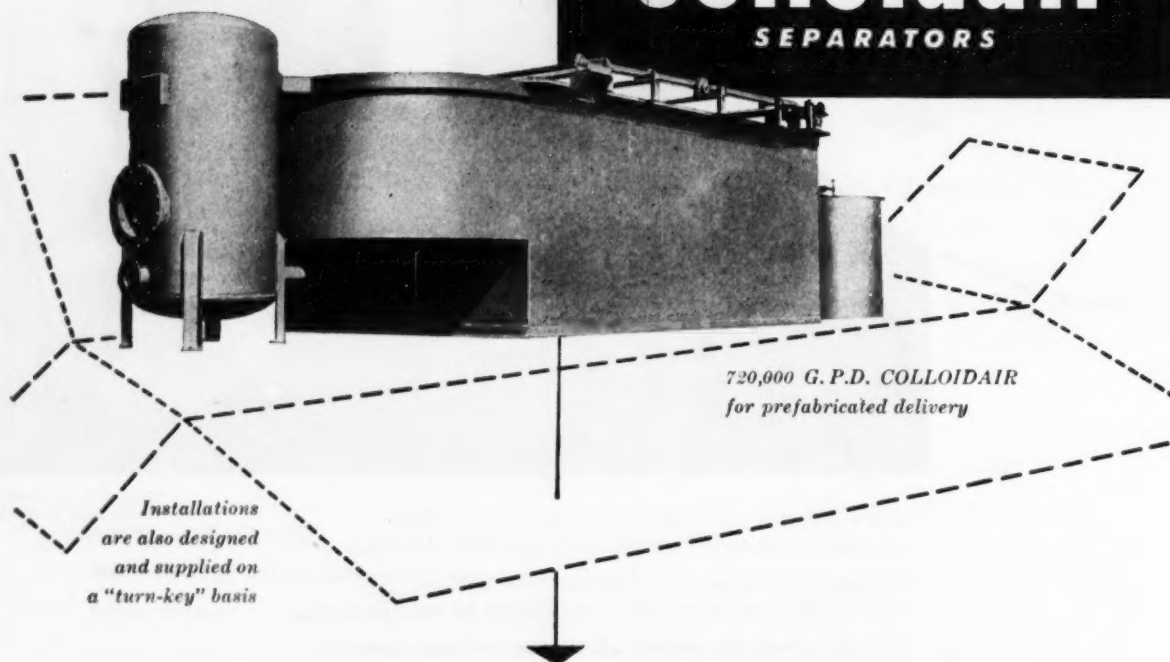
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Meets government specifications for aircraft maintenance wastes treatment facilities

This equipment meets state, regional,
and local disposal requirements with...

HIGH EFFICIENCIES • LOW SPACE REQUIREMENTS • PROVEN PERFORMANCE

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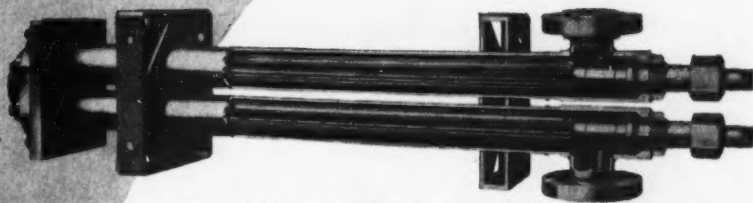
BULKLEY-DUNTON PROCESSES, INC.

Dept. P-1, 295 Madison Ave., New York 17, N. Y.

Pacific Coast: Dept. P-1, Security Bldg., Pasadena, Calif.

G-R.....

85 years of specialized experience in the design and construction of heat transfer apparatus . . . *the longest and most extensive experience in this field*



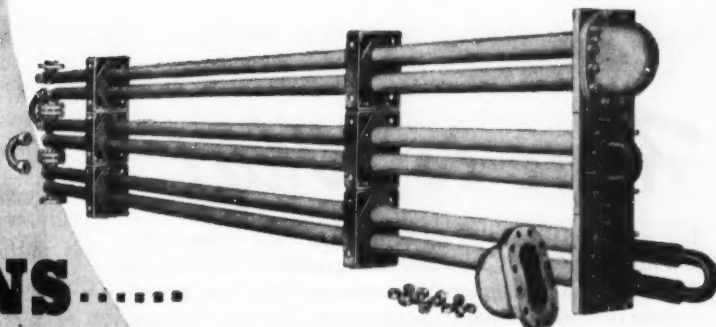
TWIN.....

a pipe within a pipe in a hair-pin design, and with closure consisting of only 3 parts . . . *the simplest heat exchanger design on the market*



G-FIN.....

the inner pipe surrounded by securely bonded longitudinal fins with 6 to 8 times more heat transfer surface than the same length of bare tubes . . . *the most effective design for transfer of heat between fluids of unequal heat conductivity*



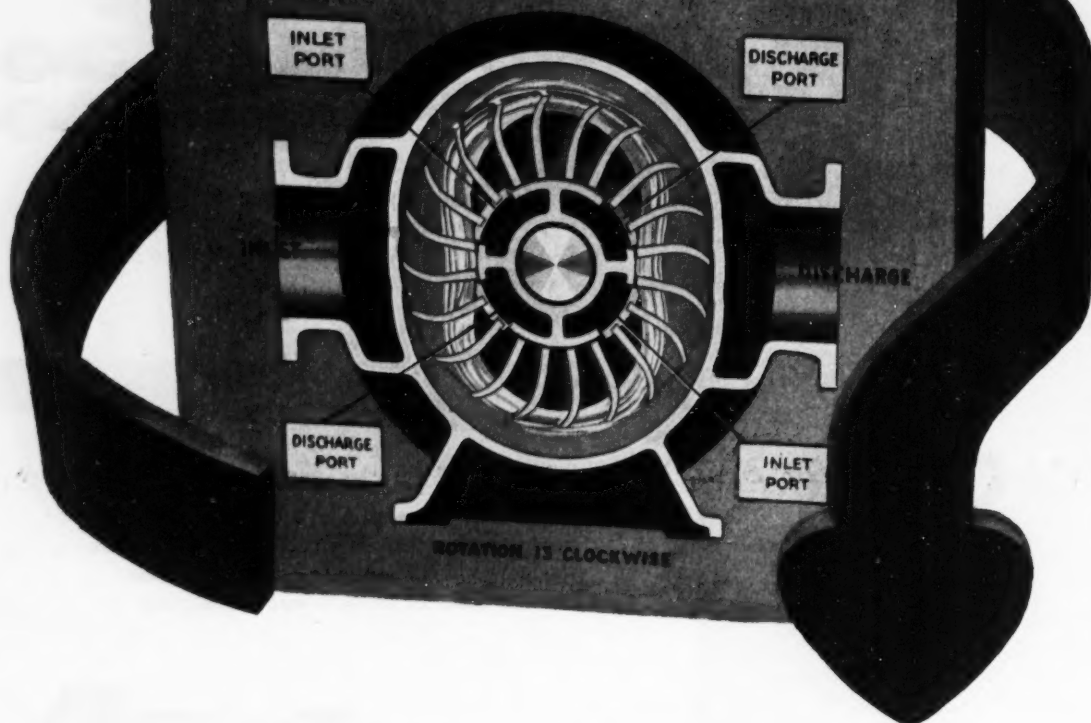
SECTIONS.....

standard, interchangeable units that can be arranged in series or parallel, and increased or decreased in number, for any desired capacity and temperature range . . . *the widest adaptability of any heat transfer apparatus for heating, cooling, condensing or heat exchanger services*

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PIONEER IN HEAT TRANSFER APPARATUS



**Nash Instrument Air Compressors
deliver only clean air, free from
oil or dust, and without filters**



Here is Why!

You can dispense with oil filters and dust filters when you install **Nash® Clean Air Compressors**. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

No oil filters.

No dust filters.

**No internal lubrication to
contaminate air handled.**

No internal wearing parts.

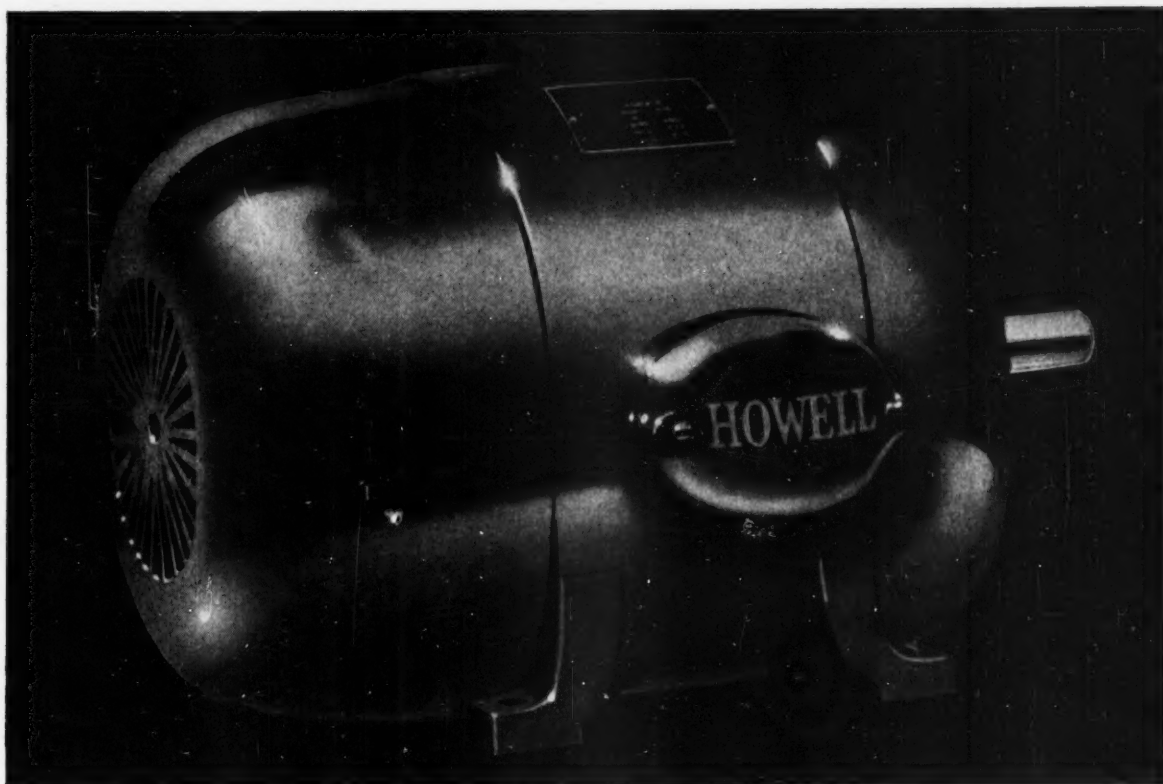
No valves, pistons, or vanes.

Non-pulsating pressure.

**Original performance constant
over a long pump life.**

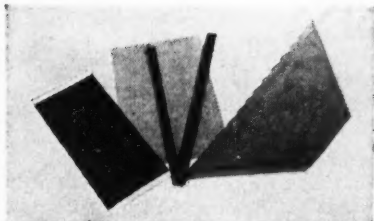
Low maintenance cost.

NASH ENGINEERING COMPANY
395 WILSON, SO. NORWALK, CONN.

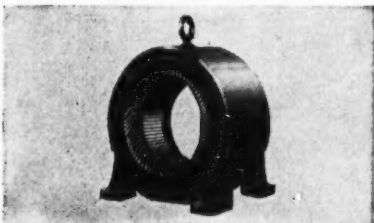


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Totally enclosed, protected against dust, fumes and moisture—the best looking motors your money can buy!



More and better insulation. Each slot cell has seven different pieces of insulation. Top and bottom coils and phase groups are insulated. Howell insulation is unsurpassed in quality.



Improved coil varnish. Type K stators are thoroughly impregnated twice with a phenolic, resin base varnish, and twice baked for unusual protection against moisture, dust, oil, weak acids and mild alkalis.

Howell Type K Motors outperform and outlast any open-type motor. Totally enclosed, all working parts are protected against the destructive action of dust, dirt, fumes and moisture. The fan-cooling prevents motor overheating.

The all-steel, streamlined housing conforms to the most modern trends in machine-tool

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Howell Type K Motors are available in all electrical types, from 1½ to 300 hp. at 1800 rpm., with vertical or horizontal mounting.

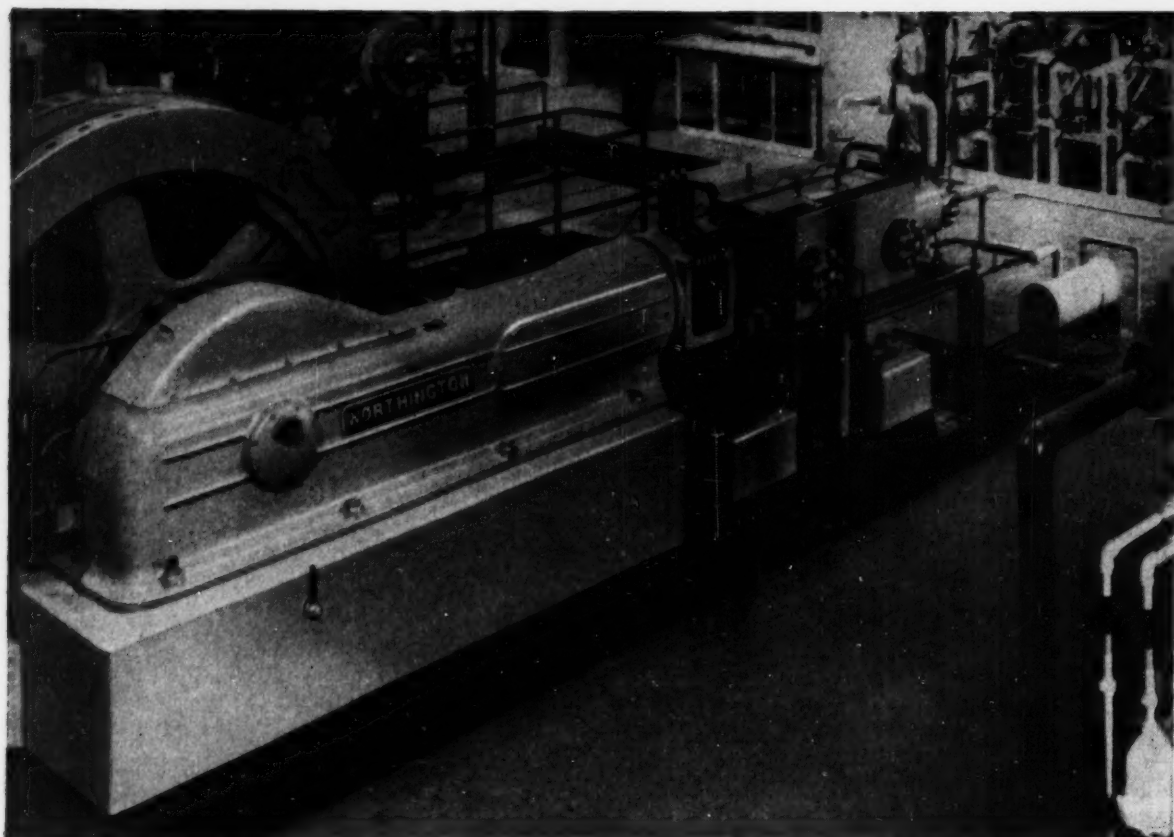
For more complete information on Howell's Type K Motors, contact the Howell man in your area, or write the factory for Bulletin K-2.



HOWELL MOTORS

HOWELL ELECTRIC MOTORS COMPANY, HOWELL, MICHIGAN

PRECISION-BUILT MOTORS FOR INDUSTRY SINCE 1915



HIGH-PRESSURE WORTHINGTON RECIRCULATOR-COMPRESSORS help to manufacture synthetic ammonia at the Hooker Electrochemical Company in Tacoma, Washington. Gaseous nitrogen and hydrogen are compressed, circulated through a catalyst, and converted under maintained pressure and temperature into synthetic ammonia. The Chemical Construction Corporation of New York engineered this installation.

Hooker uses efficient Worthington unit in NH_3 synthesis

The Hooker Electrochemical Company in Tacoma needed a recirculator-compressor that would operate dependably and efficiently at the extremely high pressures involved in the manufacture of synthetic ammonia.

Worthington answered this need by supplying a Worthington High-pressure Recirculator-Compressor, with a discharge pressure of over 5000 psig. This was a routine operation for Worthington engineers, since they have furnished similar units on many previous occasions.

The compressor cylinder, complete with packing boxes, is a one-piece forging. The piston rod, piston and tail rod are also integrally forged. These features insure the ac-

curate alignment essential to successful operation of high pressure equipment. And this alignment is maintained throughout years of operation.

This is another example of the way a manufacturer benefits by Worthington's skilled application engineering and the completeness of the Worthington line. Because Worthington manufactures compressors of every size and type, there's a Worthington machine that will exactly fit *your* needs. Get in touch with your nearest Worthington district office, or write to Worthington Corporation, Compressor Division, Section K.3.2, Buffalo 5, N. Y.

K.3.2

WORTHINGTON



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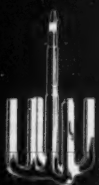
Quikupl



valve



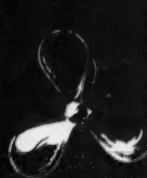
impeller



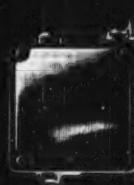
mixer



fitting



propeller



filter plate



COOPER ALLOY

THE COOPER ALLOY FOUNDRY CO. • HILLSIDE, N. J.

Los Angeles San Francisco Oakland Houston Chicago Detroit Philadelphia Hartford
Leading producers of STAINLESS STEEL valves, fittings and castings

SPECIAL KILN...

designed and built by Vulcan for
The New Jersey Zinc Co. (of Pa.)



The kiln illustrated above is designed with parts that are exceedingly heavy, because of its type of work. It is 11'3" x 161', used for the WAELEZ Process. The supporting bearings, for example, are the largest ever made by Vulcan or any other company. Every other part of this mammoth kiln is correspondingly heavy. The drive is so

arranged that the kiln may be driven from either the motor or an auxiliary steam turbine, which is capable of running the kiln at operating speeds.

Because of the product involved, the kiln is tightly sealed against the escaping of interior gases or the admission of outside air.

**Any information on items listed below
will be sent to you immediately:**

Rotary Kilns, Coolers and Dryers	Heavy Duty Electric Hoists
Rotary Retorts, Calciners, Etc.	Self-Contained Electric Hoists
Improved Vertical Lime Kilns	Cast-Steel Sheaves and Gears
Automatic Quick-Lime Hydrators	Diesel Locomotives
Briquetting Equipment	Electric Locomotives and Larrys
Open-Hearth Steel Castings	Steel Plate Fabrications
	Hydraulic Presses

The above installation of a Vulcan Rotary Kiln again shows the result of fine co-operation between the engineering personnel at Vulcan and the engineering personnel and operators at The New Jersey Zinc Company (of Pa.). This great organization, together with many more throughout the United States and the World, have ordered and re-ordered Vulcan of Wilkes-Barre equipment: re-ordered because of its time-tested performance. If any information regarding kilns for any application is needed, the Vulcan Iron Works and its 105 years of experience is ready and able to serve you. Write for detailed Bulletin No. A-442, today.

VULCAN IRON WORKS

NEW YORK OFFICE
50 CHURCH ST., N.Y., N.Y.

WILKES-BARRE, PA., U.S.A.
ESTABLISHED 1849

CABLE ADDRESS
"VULWORKS WILKESBARRE"



Save time with quick-dissolving HOOKER SODIUM SULFIDES

get clear solutions in 15 minutes

Your production men can work fast with these Hooker sulfides.

The flakes dissolve in 15 minutes, even without stirring—and in cold water. They give a clear solution, free of sediment—ready for immediate use, with no decanting.

Hooker sodium sulfide is a light buff-colored material in flake or solid form. It contains 60 to 62% Na_2S . Flake form is shipped in lacquer-lined steel drums, 90 and 350 lbs. net. Solid form comes in steel drums, 625 lbs. net.

Hooker sodium tetrasulfide is a dark red aqueous solution con-

taining 40% by weight of Na_2S_4 . The solution contains less than 1% sodium thiosulfate, sodium carbonate, and sodium sulfite inclusive. It is shipped in 55-gal. steel drums, 600 lbs. net.

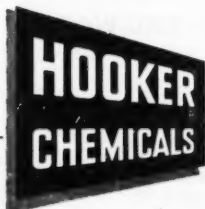
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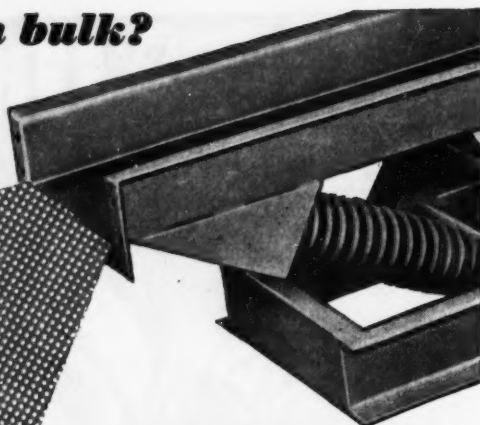
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moving granular material in bulk?



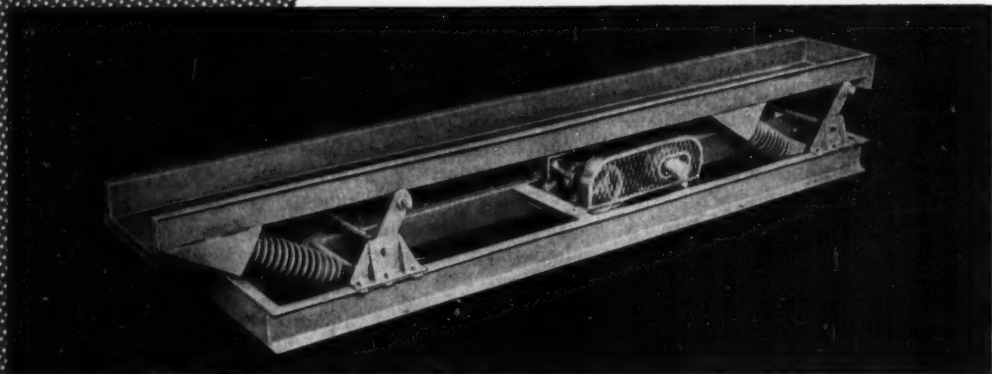
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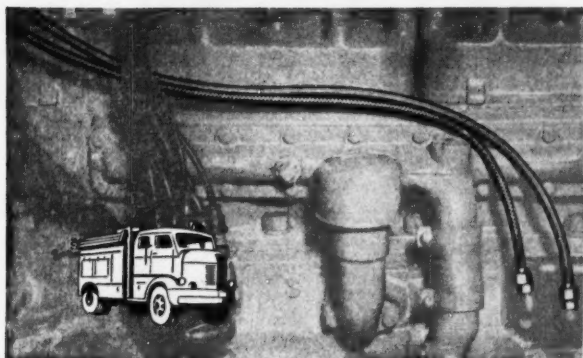
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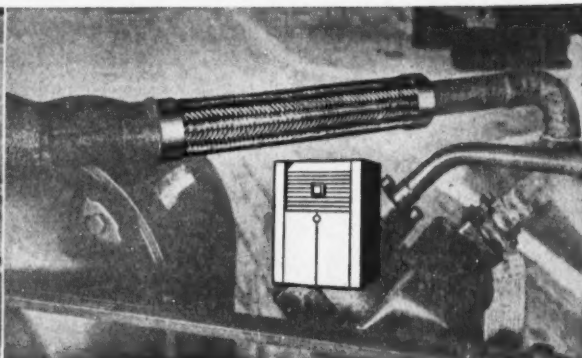
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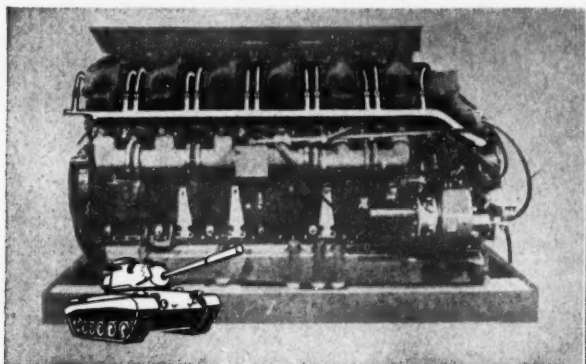
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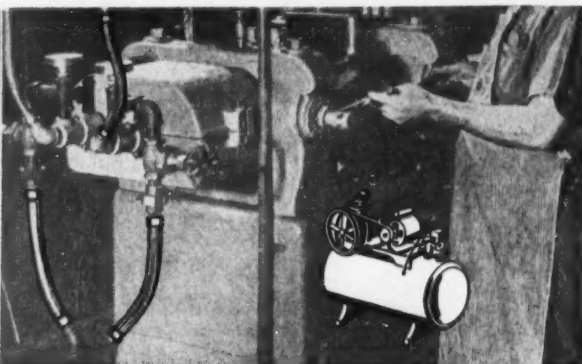
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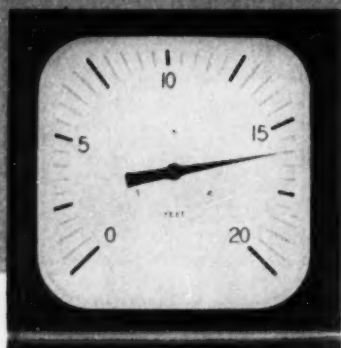


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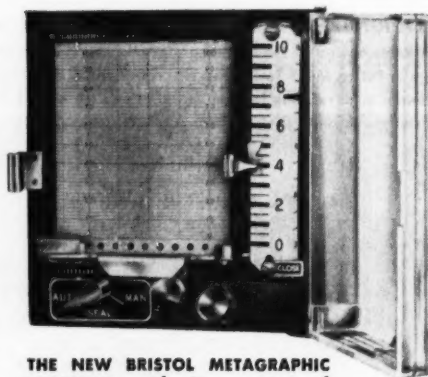
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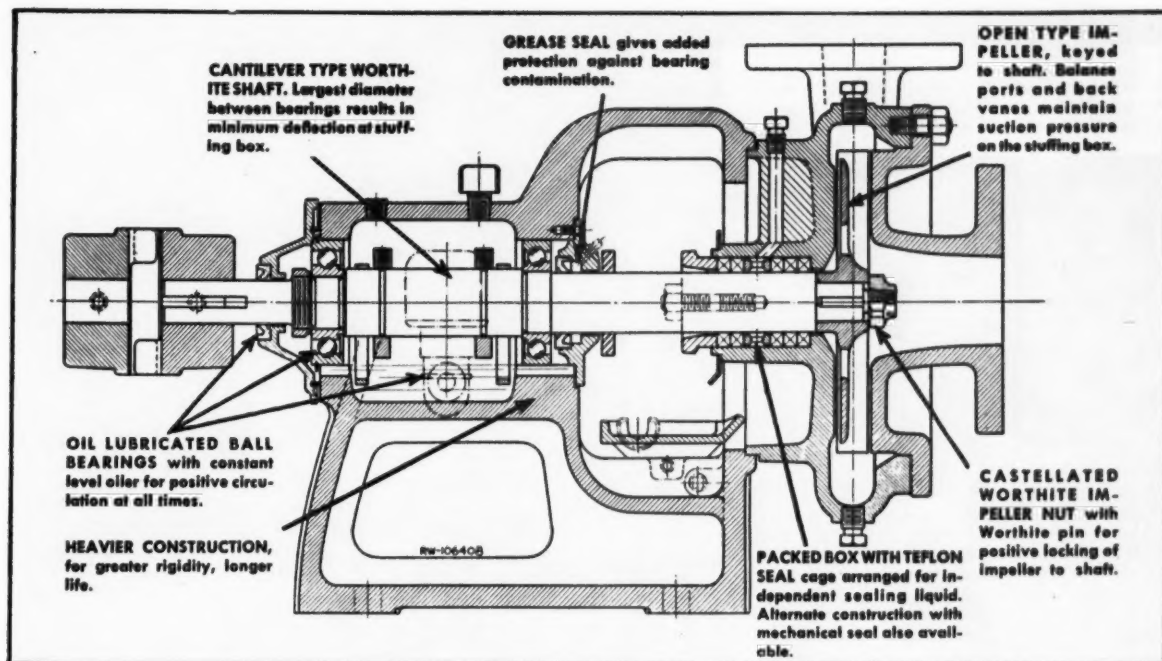
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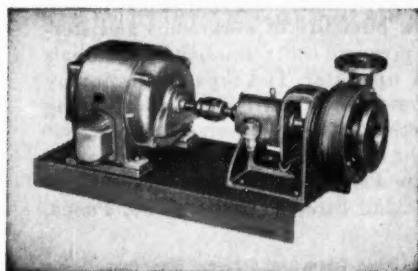
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Worthington also increases size and capacity range of Worthite pumps, standardized with packed box or with Worthington mechanical seal



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C.3.7



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Type CN. Single stage. Sizes ½ in. to 6 in. Capacities up to 2400 gpm; heads to 390 ft.

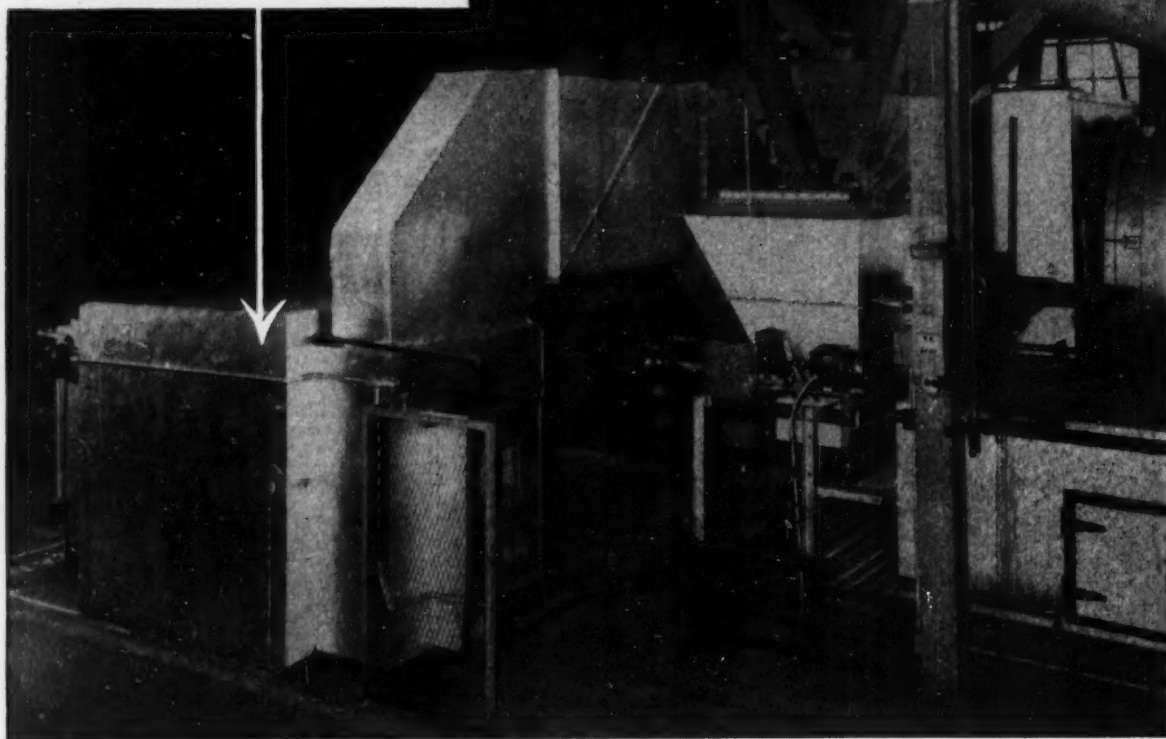


BOILER FEED PUMPS

Capacities up to 2000 gpm; pressures to 1250 psi.



A Lectrodryer feeds DRY air to a Louisville drier at the Norfolk, Virginia plant of Mitchell & Smith Company, makers of pressed-cork products.



DRY AIR is part of their formula in blending powdered cork

Formulation of cork products calls for some water, but not as much as the raw cork usually contains. Some of the moisture must be removed by tumbling the powdered cork in a rotary drier, through which heated DRY air is passed.

Lower air temperatures—desirable to prevent injury to the cork—can be employed when that air is preconditioned by a Lectrodryer,* since DRY air removes moisture faster.

You can make DRYing a part of your formulas by installing Lectrodryers to remove

unwanted moisture from air, gases and organic liquids. Delicate chemical reactions can then be held on the straight and narrow path more easily. Low humidity in workrooms and storage areas prevents contamination of materials that pick up water. It keeps them moving freely in machines and conveyors, speeding up production.

For help in adding DRYing to your processes, write Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Penna.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.

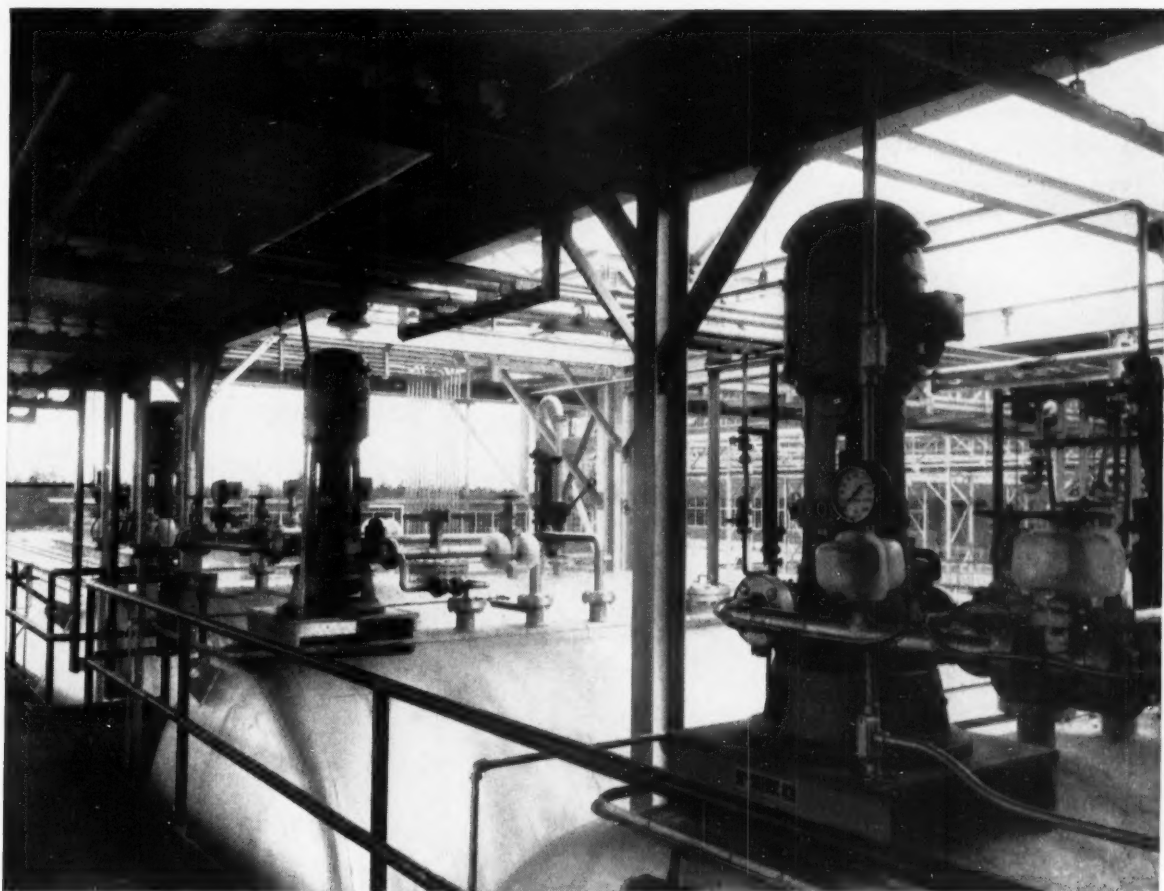
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.

In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

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LECTRODRYER

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Natural Habitat

One look at this picture tells you that the men who designed this plant knew exactly what they were doing. Layout, installation and maintenance are obviously the work of highly competent individuals, backed by a company that means business.

There are eight LaBour Type BG pumps in this complete installation at Toms River, N.J., in the plant of Ciba States Limited. One pump handles 65% oleum under a 10½ ft. static suction lift; the pump in the foreground handles 96% sulfuric acid.

It's not surprising to find LaBour pumps in a picture like this. The men who can do this kind of a job know that LaBours *belong* there. They understand that continuity of operation with minimum interruption for repair and maintenance, is the key to profit.

That knowledge is reflected throughout this plant—accounting, of course, for selection of the LaBour pumps.

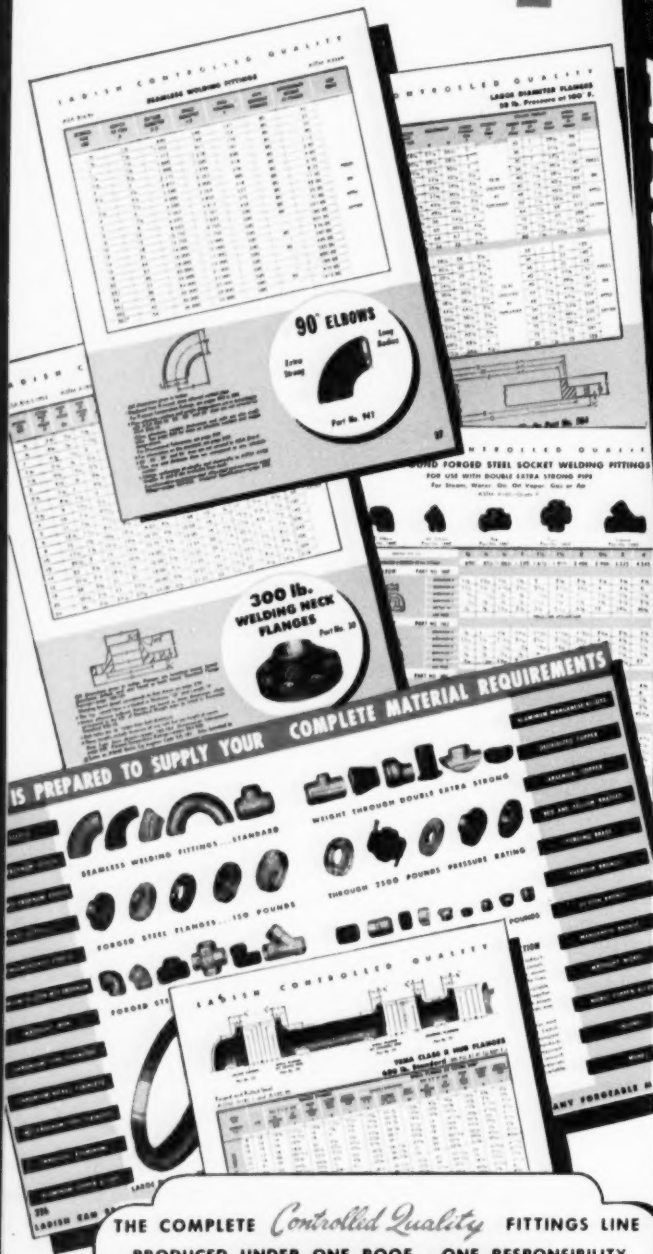
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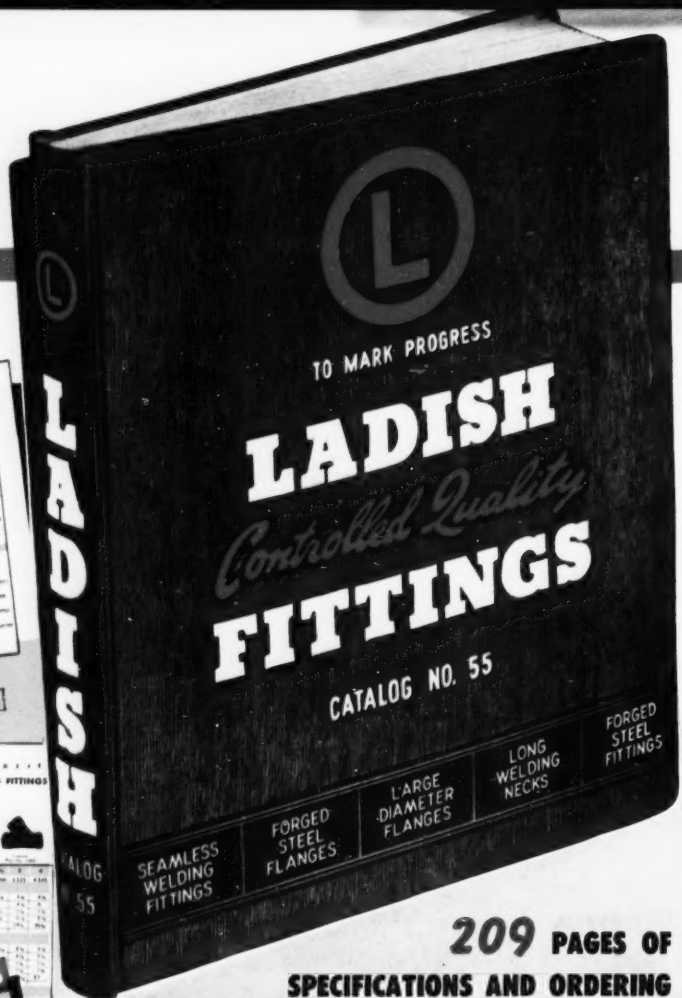


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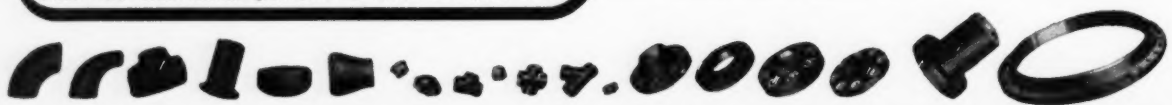
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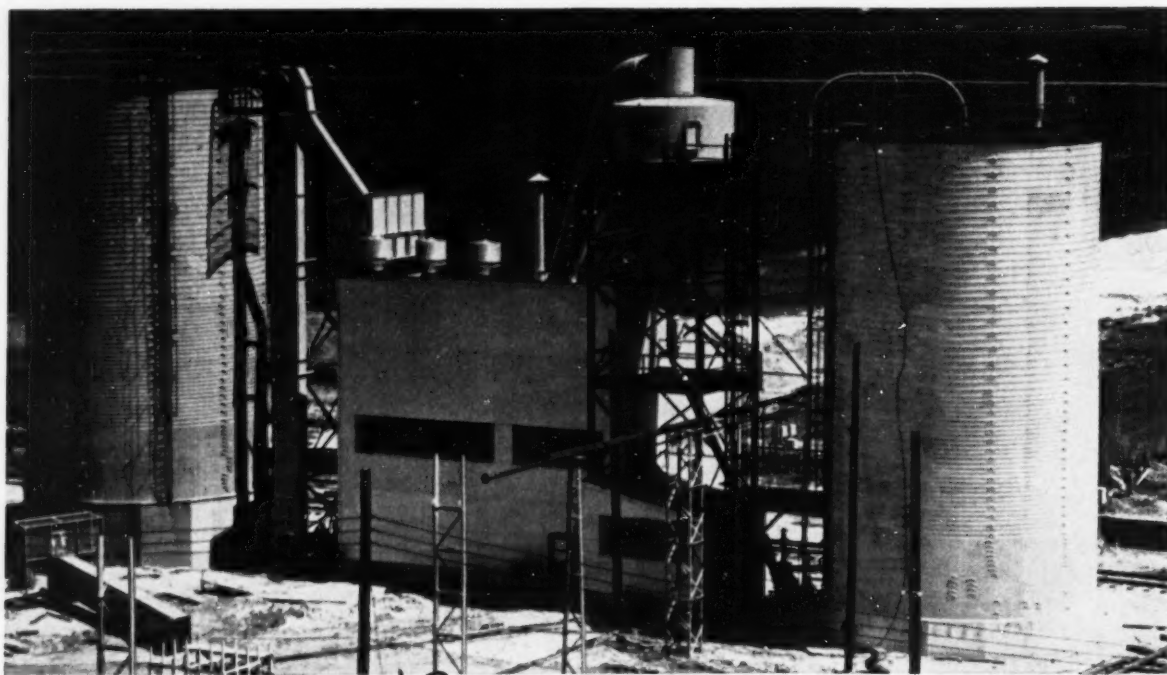
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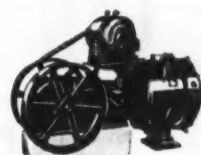
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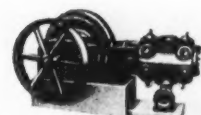
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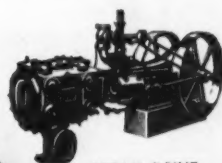
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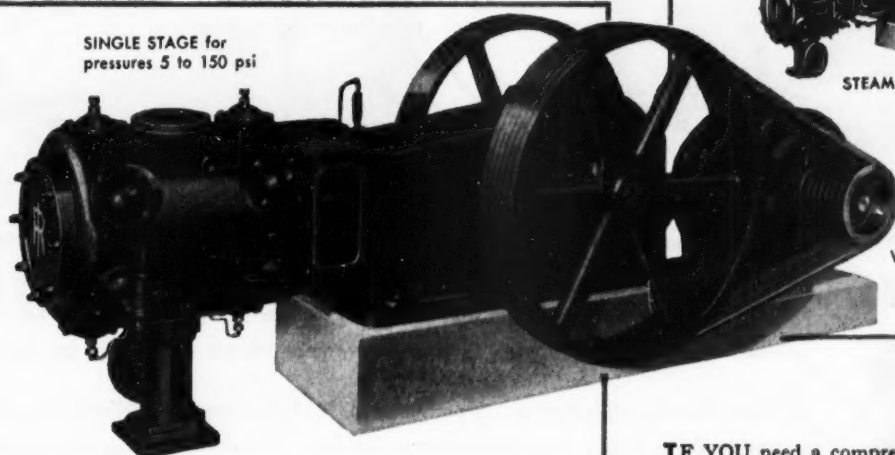
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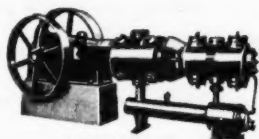


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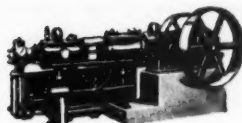


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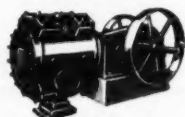
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150 to 500 psi



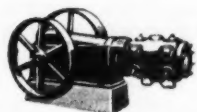
THREE STAGE for
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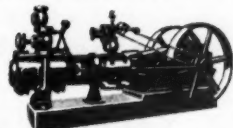
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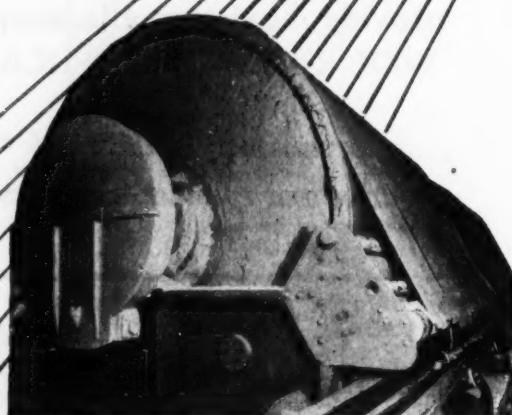
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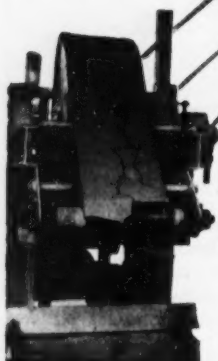
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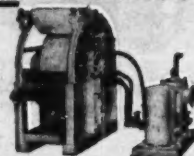
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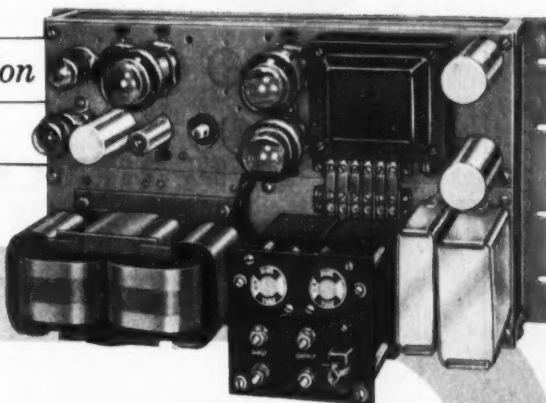
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Input Range

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Output Range — Output voltage on 115 volt units can be adjusted from 110 to 120 volts; on 230 volt units from 220 to 240 volts.

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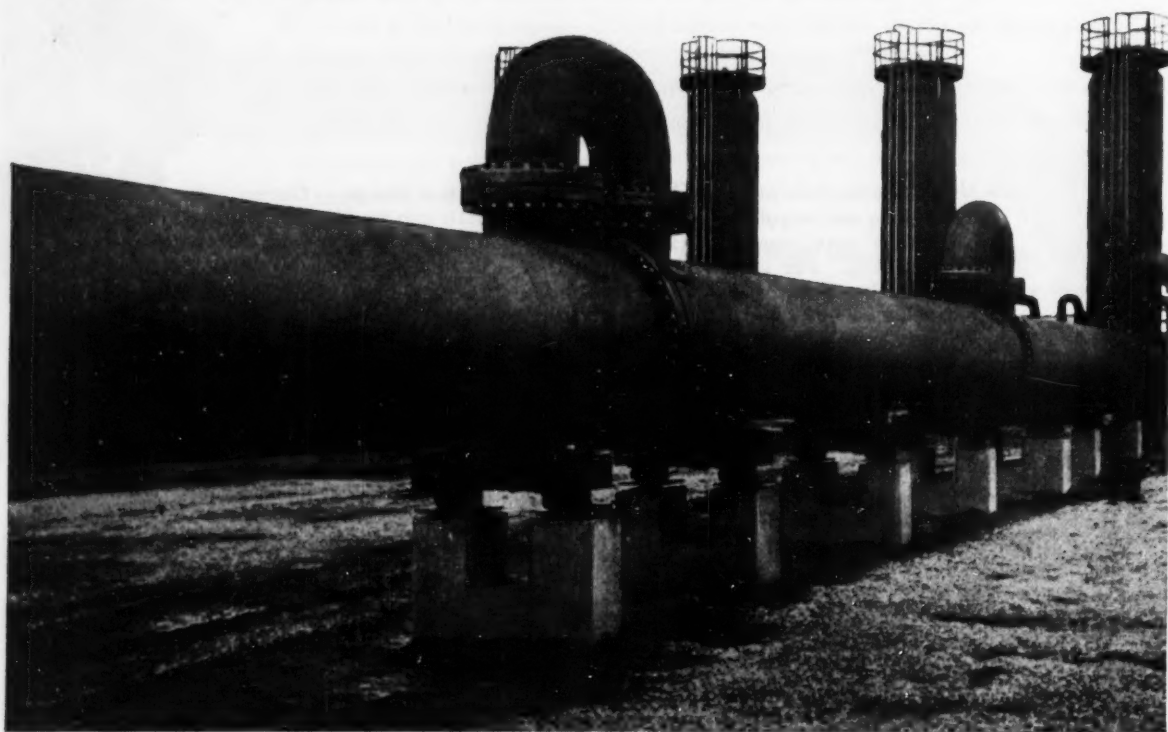
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and

Alco FACILITIES

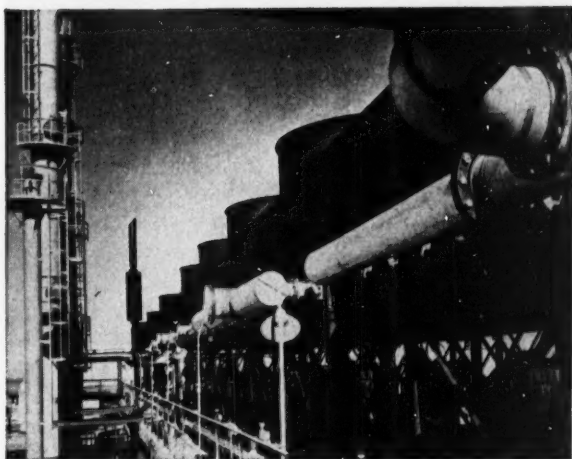
...capable of handling economically an extremely wide range of metal-fabricating operations...of meeting strictest customer specifications.



150 FT "TRAIN" HEAT EXCHANGERS, designed and built by Alco with special flange-to-flange construction, step up efficiency at Tennessee Gas Transmission Company's huge gas processing plant at Gabe, Kentucky. Other Alco units at Gabe include ethylene flash drum, demethanizer tower, primary feed cooler.

PROCESSING problems

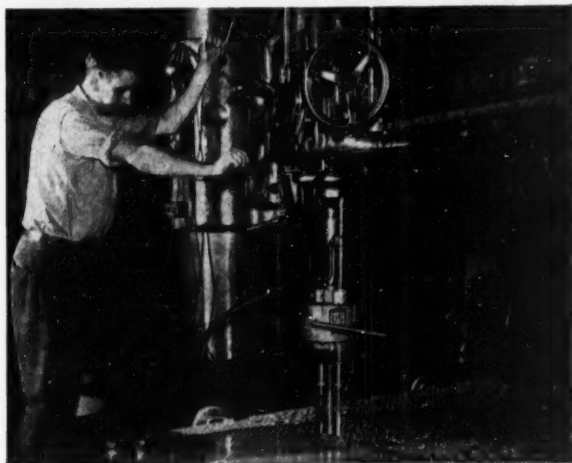
...examples of the wide variety of heavy-metal equipment designed and built by Alco to meet today's demands in petroleum and petrochemical processing.



SPECIAL ALCO AIRCOOLERS, with many components of aluminum and stainless steel, handle 80 percent of cooling load at Celanese Corporation's new 630-acre petrochemical plant at Pampa, Texas. Units have removable headers and slide-out tube bundles, operate in constant presence of highly corrosive acids, chemicals and gases.



PRIMARY AND ATMOSPHERIC TOWER CONDENSERS, plus stabilizer condenser, naphtha cooler, kerosene and diesel oil exchangers, are among the many Alco units at Canadian Oil Refineries' new \$23,000,000 plant at Sarnia, Ontario. This plant produces more than 115,000,000 gal. of gasoline annually, claims first catalytic reformer in Canada.



EIGHT FOOT RADIAL DRILL at Alco's modern, completely equipped plant at Dunkirk, N.Y., has multiple head for the precision drilling or reaming of several holes simultaneously. Unique facilities like this, many of them Alco designed, enable Alco to fabricate dependable, profit-building answers to toughest processing problems.

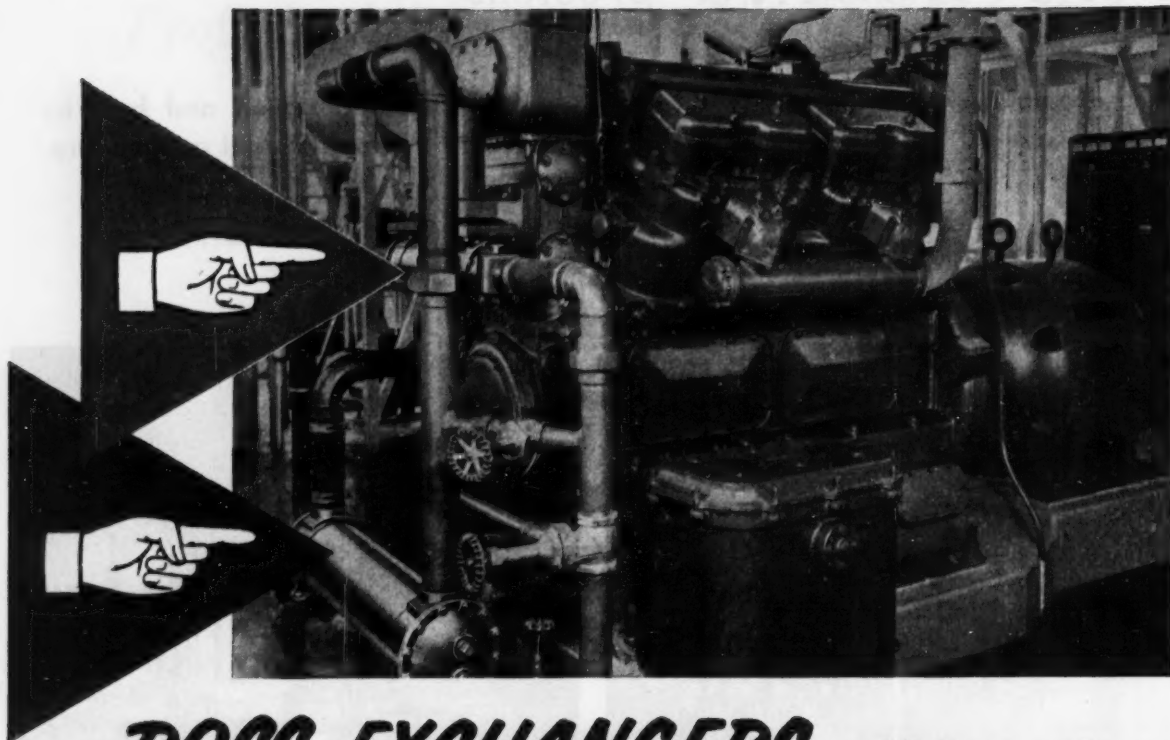
Let Alco facilities and experience produce profit-building answers to your processing problems. Contact your nearest Alco Products sales representative today. Offices in Dunkirk, New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

ALCO

ALCO PRODUCTS DIVISION

AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, NEW YORK

Ready for any emergency



ROSS EXCHANGERS will keep these **CATERPILLAR** standby diesels running cool

REG. U. S. PAT. OFF.

Ready for instant action, this Caterpillar D364 Diesel Electric Set and its mate are on the alert to supply emergency power for a large, widely-known gas storage pumping station.

To provide dependable temperature control, Caterpillar Tractor Co. factory-installed two Ross Type BCF Exchangers on each engine: One to cool lube oil . . . one to cool jacket water. *There'll be no overheating here!*

Ross Exchangers are also integral components of many other Caterpillar Diesel Engines supplying power for oil field drilling rigs, pipeline construction jobs, earth moving machinery, ditchers and work boats.

Ranked first for high thermal efficiency and ruggedness by first-ranking equipment builders, all-copper and copper alloy Ross Type BCF Exchangers are pre-engineered, fully standardized and promptly available. For more information, request Bulletin 1.1K5.

KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

1411 WEST AVENUE • BUFFALO 13, N. Y.

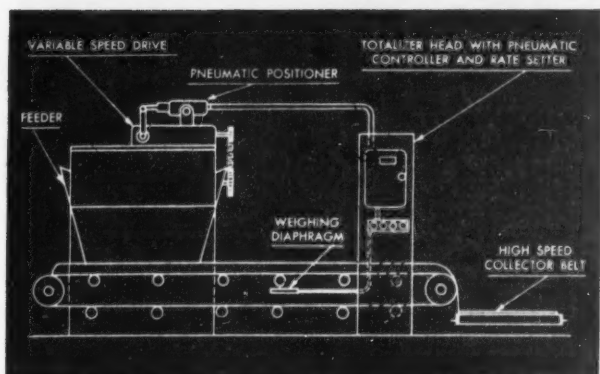
In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.



Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNDHAM AIR CONDITIONERS

WEIGH IT

...on the Go!

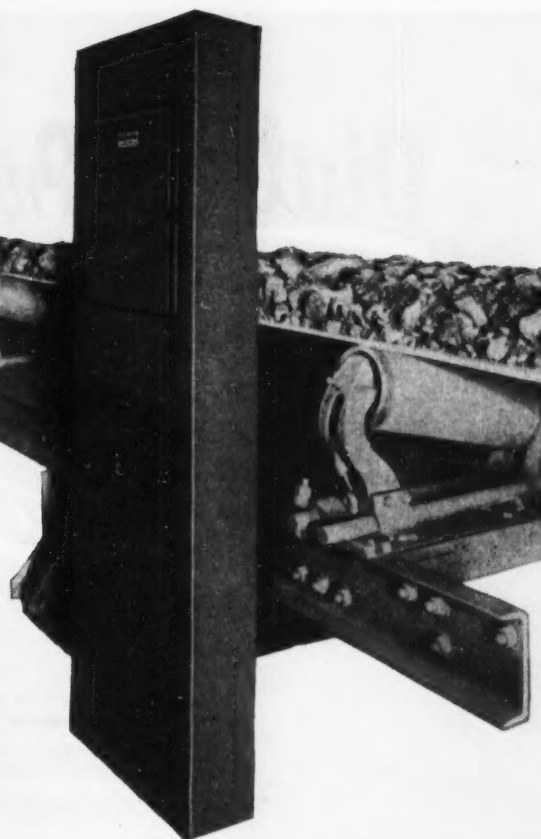


Typical Conveyoflo installation showing Model CFAB-T Conveyoflo Meter controlling flow of tobacco in automatic blending process. Conveyoflo employs pneumatic controller to automatically control feeder output within very narrow tolerances.

Conveyoflo Meters are serving in many other process industries: food, soap, fertilizer, pharmaceutical, steel, paper, glass, heavy chemicals, mining, power. What's your processing problem?

CONVEYOFLO FEATURES

- **ACCURATE** . . . within $\pm 1\%$ of actual weight from maximum to 50% of rated capacity; within 1% from 50% to 25% rate; within 2% from 25% to 10% of meter's rated capacity.
- **COMPACT** . . . weight sensing mechanism completely contained within conveyor structure. No overhead levers. Panel stand only 9" x 18" — may be any height.
- **AUTOMATIC TOTALIZER COMPENSATION** for variations in belt speed and changes in belt weight.
- **RESPONDS ACCURATELY** to rapid load variations.
- **PACES AUXILIARY EQUIPMENT** (feeders, controllers, continuous blending processes, etc.) and operates secondary totalizers, indicators, recorders.



Weigh it with BUILDERS CONVEYOFLO . . . the modern meter for continuous, accurate weighing of bulk material passing over conveyor belts. This precision meter can be equipped with a Controller to maintain any desired preset rate of delivery from the conveyor in which it is installed. Or it can be used to pace auxiliary feeders in automatic processing systems. Conveyoflo is furnished as a separate, self-contained unit— or for installation in your present conveyor lines.

BUILDERS



(DIVISION OF B-I-F INDUSTRIES)



SEND COUPON FOR DETAILS

BUILDERS-PROVIDENCE, INC.
369 Harris Ave., Providence 1, R. I.

Please send Bulletin 550-H4 describing Builders Conveyoflo Meter.

Name

Company

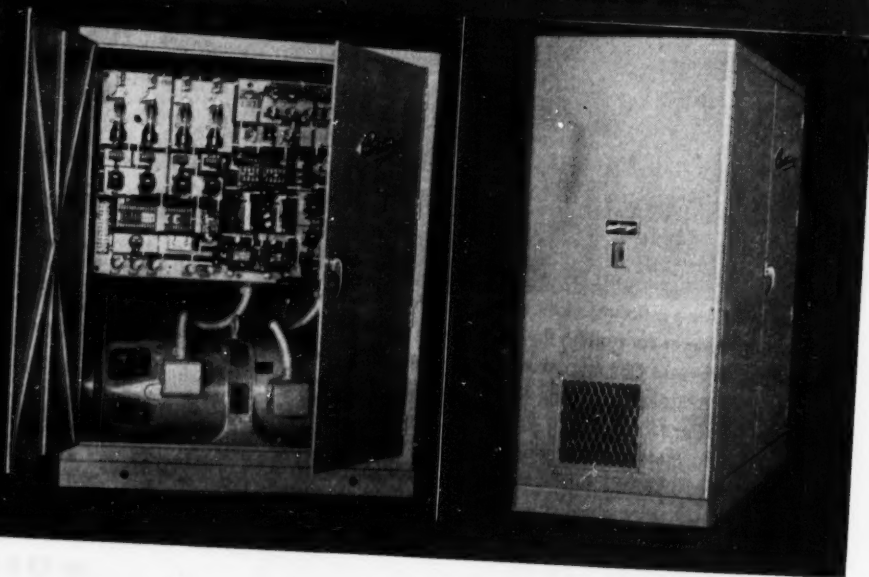
Street

City State

Dial Production Speed

Century

Drive



REDUCE OVERHEAD . . .

Save Time and Labor with this Flexible,
Fingertip Control over a wide
range of stable production speeds.

CENTURY ELECTRIC COMPANY

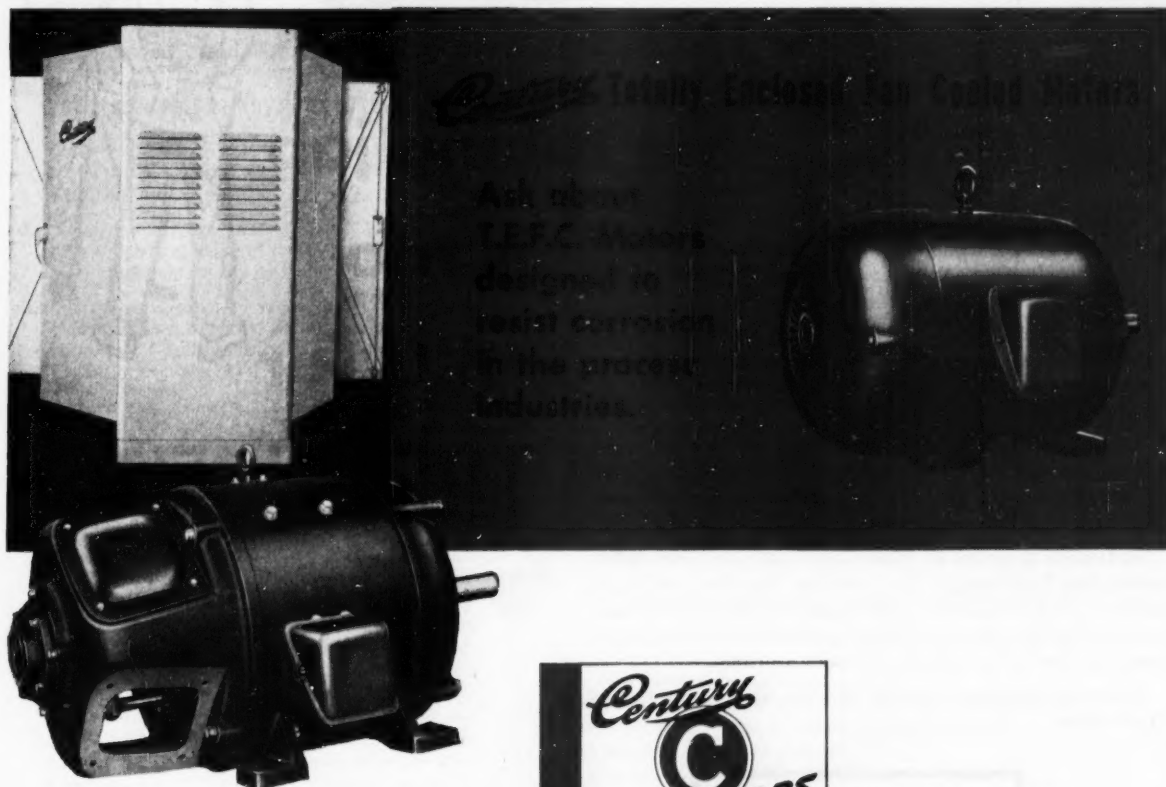


SELECTIVE SPEED, ALL ELECTRIC, MOTOR DRIVES

- Operate from alternating current.
- Offer an extremely wide range of practically stepless speed control, to cover the variable processing requirements.
- Engineered for specific application requirements, with regard to: Load jogging—load acceleration—normal or quick deceleration with adjustable dynamic braking—jog in reverse or run in reverse, or both—multiple coordinated drive motors—remote single or multiple control positions.

**Call for a Century Application Engineer TO EXPLAIN
FURTHER DETAILS OF THE CENTURY SELECTIVE SPEED DRIVE**

Side view of Power Unit. Rear doors are available when special control requires access.

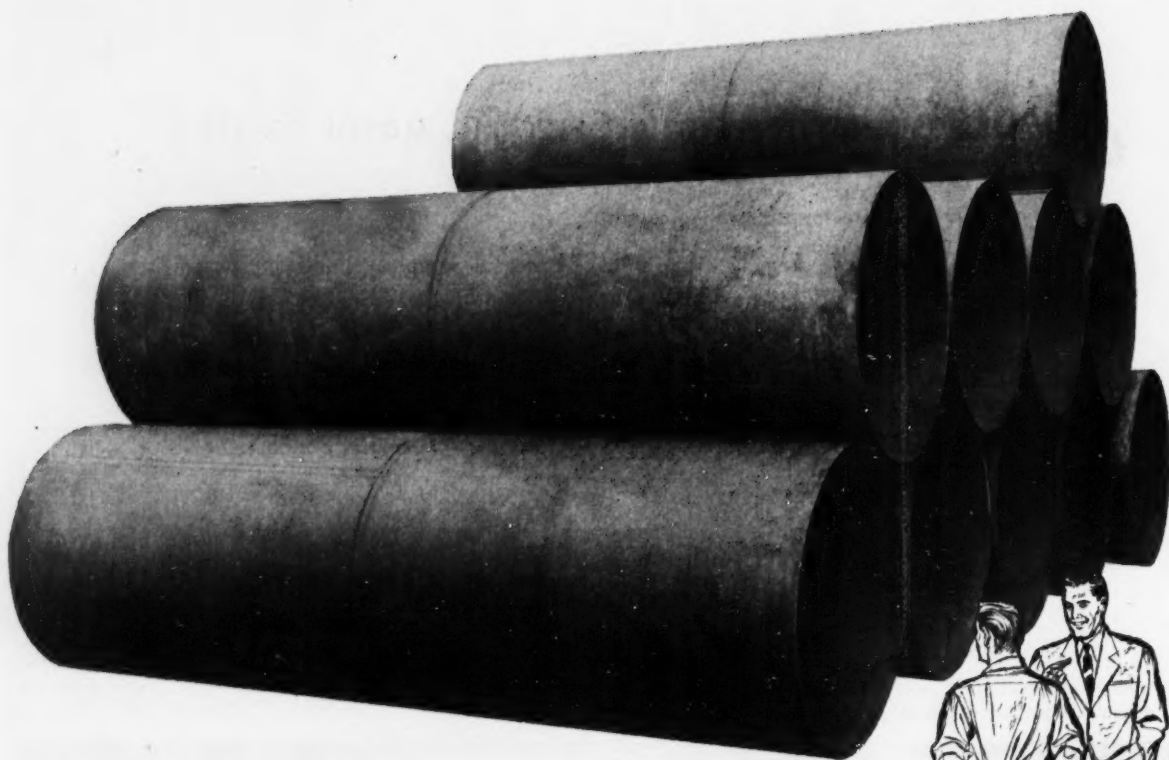


Typical drive motor which operates from the alternating current power unit.



Offices and Stock Points
in Principal Cities

778



no tubing job

is too

BIG for

TRENTWELD

A famous manufacturer, engaged in atomic energy work, had a problem. Large quantities of stainless steel tubing were required — in sizes larger than regularly manufactured commercially.

Trent solved the problem by producing a 36" O.D. x $\frac{1}{4}$ " wall stainless tube in five to six foot lengths, and then butt welded two sections together to make the ten to twelve-foot lengths required.

Your particular application may not call for extra-size tubing, but no matter what size or shape you require Trent can fill your needs promptly — we produce the largest assortment of tubing sizes in the industry, from $\frac{1}{8}$ " to 40" O.D.

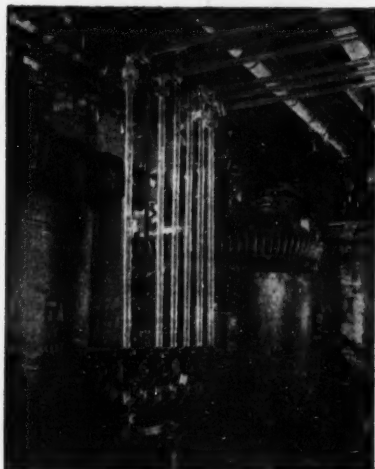
And when it comes to quality, you just can't buy better tubing than TRENTWELD. That's because TRENTWELD stainless welded tubing is a product of tube mill specialists. Each tube has a uniformly sound weld indistinguishable from the parent metal and just as strong and corrosion resistant.

Next time you need stainless or high alloy tubing specify TRENTWELD.



STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)



Far Left: PYREX brand "Double-Tough" Glass Pipe ends replacement of corroded lines... simplifies cleaning... enables you to see what's happening inside the line.

Available in 1" to 6" I. D. with all standard fittings, as well as sink traps. Your plant personnel can handle PYREX pipe without special training.

For information and pictures, check the coupon below for "PYREX brand Glass Pipe in the Process Industries" (EA-1) and "PYREX brand 'Double-Tough' Glass Pipe and Fittings" (EA-3).

Left: PYREX brand Fractionating Columns give you unusual advantages in solving fractionating and absorption problems. No corrosion, no contamination. And you see flow, performance and condition of product.

Available in 4" and 6" sizes with any number of plates.

Standard packed columns are available in 4", 6", 12" and 18" inside diameter sizes. Can be packed with PYREX brand Glass Raschig Rings. Check the coupon for data sheet of helpful information and applications.

Have YOU a corrosion problem one of these glass products can cure?

Corrosive liquids create special problems. Your pipes, coolers, and fractionating columns forever need attention, repairs or replacement. Product contamination is common. There's

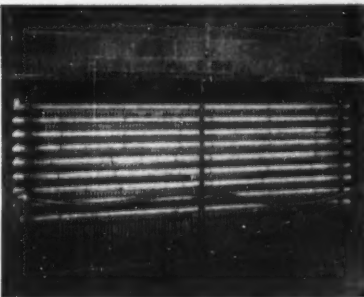
no fast, sure method of cleaning corroded equipment.

Why put up with these headaches when you can easily avoid them with PYREX brand glass equipment?

These are reasons why glass takes the headaches out of corrosive liquids:

1. *Glass does not rust* . . . It's unaffected by all acidic solutions and acids except hydrofluoric.
2. *Glass is non-contaminating* . . . The high chemical stability of PYREX brand glass equipment assures product purity.
3. *Glass is transparent* . . . You see what's happening as it happens. You have an immediate visual check on conditions within the equipment.
4. *Glass is easy to clean* . . . There's no place for deposits to build up on its hard, smooth surface.
5. *Glass is strong* . . . PYREX brand glass No. 7740, used for pipe, cascade coolers, and towers, has great physical and thermal shock resistance.
6. *Glass is economical* . . . Installation is simple. Maintenance is negligible. You will find the initial and maintenance costs of PYREX equipment low.

It will cost you nothing to find out if PYREX brand glass equipment can help you. And finding out may bring important savings. Write, wire, or phone the nearest Corning plant equipment distributor listed below. Or mail the coupon.



Above: PYREX brand Cascade Coolers give you low cost per BTU transferred, plus low cost operation. As many as 40 tubes can be stacked vertically in a single unit (20 tubes under one trough) to meet varied requirements. You can use cheap river or sea water as the coolant.

Check illustrated bulletin (PE-8) on the coupon for complete information on PYREX brand Cascade Coolers. It demonstrates why PYREX tubes provide high heat transfer.

DISTRIBUTOR LIST

BELMONT, CALIFORNIA	Glass Engineering Laboratories
FRESNO 17, CALIFORNIA	Valley Foundry & Machine Works
NEW HAVEN, CONNECTICUT	Macalaster Bicknell Company
ATLANTA, GEORGIA	Southern Scientific Company
CHICAGO 44, ILLINOIS	Fred S. Hickey, Inc.
NEW ORLEANS, LOUISIANA	W. H. Curtin & Company
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ST. LOUIS 4, MISSOURI	Stemmerich Supply, Inc.
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ROCHESTER 3, N. Y.	Will Corporation
HATBORO, PA.	Sentinel Glass Company
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HOUSTON 7, TEXAS	W. H. Curtin & Company
SEATTLE 4, WASHINGTON	Scientific Supplies
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MONTREAL 3, QUEBEC, CAN.	Fisher Scientific Company, Ltd.
VANCOUVER, B. C., CAN.	Scientific Supplies



Corning means research in Glass

CORNING GLASS WORKS

Dept. CE-2, Corning, N. Y.

Please send me the material checked below:

"PYREX brand 'Double-Tough' Glass Pipe and Fittings Catalog" (EA-3) ☐

"PYREX brand Glass Pipe in the Process Industries" (EA-1) ☐

"PYREX brand Cascade Cooler Bulletin" (PE-8) ☐

Data sheet on Fractionating Columns ☐

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

The fittings that revolutionized pipe welding . . .

In the year 1931 Taylor Forge gave industry its *first real line* of seamless, butt-welding pipe fittings. We say it was the first *real* line because it was the first to include not only long and short radius ells, but also full branch and reducing tees, concentric and eccentric reducers, stub ends, caps and welding neck flanges.

This was a fully planned development. Many years before Taylor Forge had foreseen the future of the butt-welding fitting . . . had realized that pipe welding could not go beyond its then crude stage until pipe users were given *all* the fittings necessary to make up complete piping systems.

So Taylor Forge went to work on this and after long research and development came out with the full line that became the inspiration of modern pipe welding.

Naturally the organization that started ahead has kept ahead . . . in design, in quality, in breadth of line. That is why so many men who have followed the development of the WeldELL line, refuse to consider any other kind of welding fittings.



TF

For up-to-the-minute facts,
see your Taylor Forge distributor
513-0254

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Starting point for quality products

Quality products begin with quality ingredients. That's why Nialk

Chemicals are used today in so many exacting applications.

for example...

NIALK TRICHLORethylene: For fast, low-cost degreasing of metal parts, NIALK TRICHLORethylene is enjoying a rapidly growing acceptance. This superior degreasing agent cleans and dries in record time...is nonflammable...can be heated by either gas, steam or electricity...and is completely re-usable after distillation.

It is dependable performance like this that has earned for all NIALK chemicals the confidence of many American industries.

NIAGARA ALKALI COMPANY

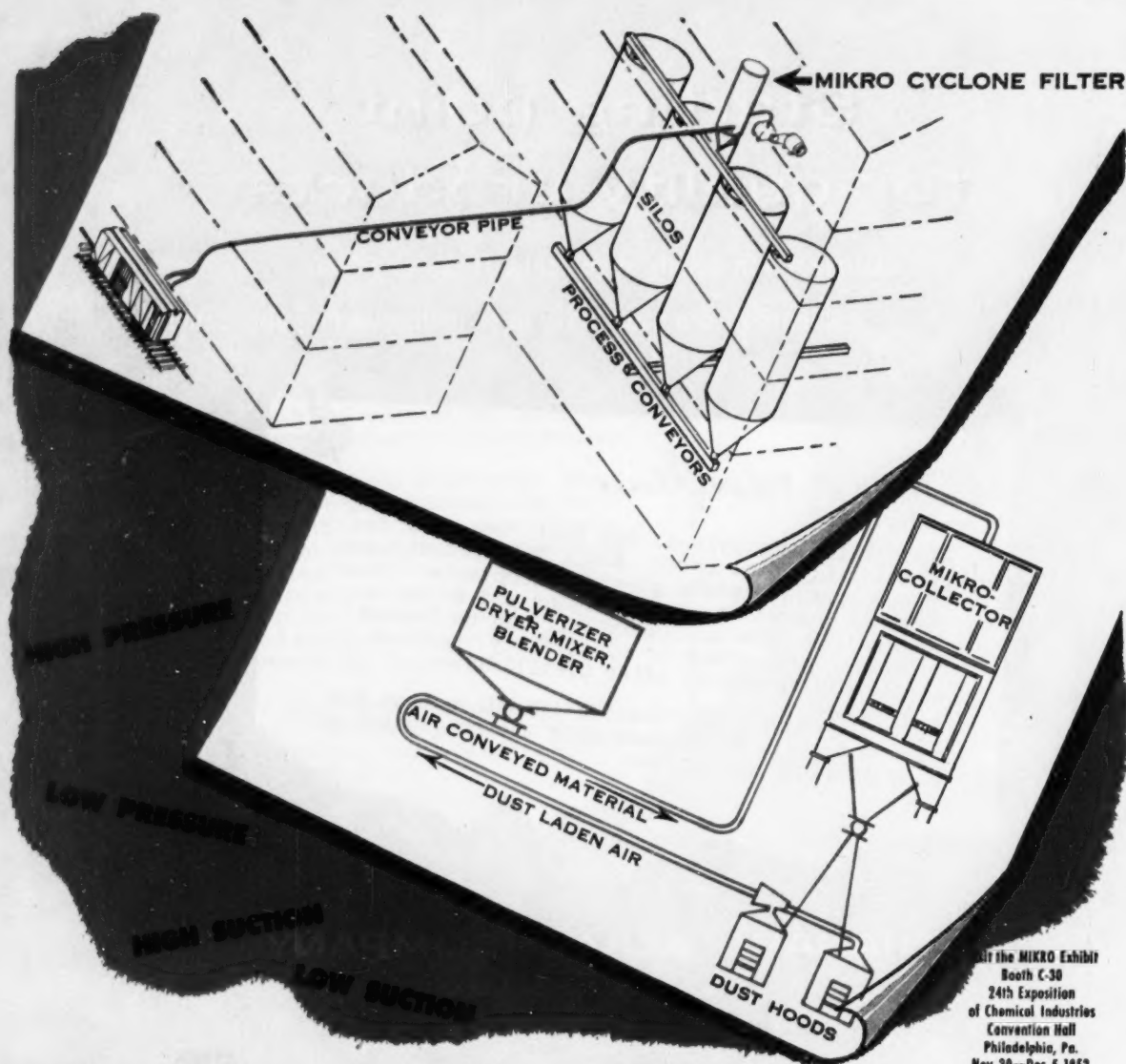
60 East 42nd Street, New York 17, New York

Nialk

LIQUID CHLORINE
CAUSTIC POTASH
CARBONATE OF POTASH
PARADICHLOROBENZENE
CAUSTIC SODA
TRICHLORethylene

NIAGATHAL (TETRACHLORO PHTHALIC ANHYDRIDE)





Visit the MIKRO Exhibit
Booth C-30
24th Exposition
of Chemical Industries
Convention Hall
Philadelphia, Pa.
Nov. 30—Dec. 5, 1953

What is Your conveying problem?

MIKRO is the answer!

The MIKRO line of pneumatic conveying equipment offers the answer to a wide range of materials handling problems.

Built in low or high pressure types—from lowest suction for short runs, using as little as 12 inches of water—up to high suction jobs employing 10 psia, transferring materials between steps in processing operations, or conveying large bulks of materials from processing to storage, or from cars to storage, etc.

The MIKRO-AIR CONVEYING SYSTEM provides an ideal, modern method of conveying materials from any source. Completely flexible, it solves and greatly simplifies plant layout problems. Dust-tight, it assures freedom from infestation and contamination, and is easily cleaned. Handling of radio-active dusts is accomplished with perfect safety. Separate cyclone is eliminated.

Collection equipment used is also adaptable for central vacuum cleaning operations.

System can be used in layouts integrating dryers, mixers, blenders, MIKRO-PULVERIZERS, MIKRO-ATOMIZERS and MIKRO-COLLECTORS, storage packaging equipment and for incidental air clarification. The MIKRO-AIR CONVEYING SYSTEM is easier and more economical to install, operate and maintain.

Write now for information.

PULVERIZING MACHINERY COMPANY
55 CHATHAM ROAD • SUMMIT, NEW JERSEY



MIKRO- AIR CONVEYING SYSTEM

ALSO MAKERS OF
MIKRO-PULVERIZERS • ATOMIZERS • COLLECTORS

2709

PRESERVE OUR HERITAGE: FAITH, FREEDOM AND INCENTIVE



TOP

LUBRICATED PLUG VALVE (Fig. 2201 FE), flanged end, available with Screwed or Bolted Glands. Semi-Steel valves available for 175 and 200 pounds W.O.G. Carbon Steel valves available for 150 and 300 pounds W.P.

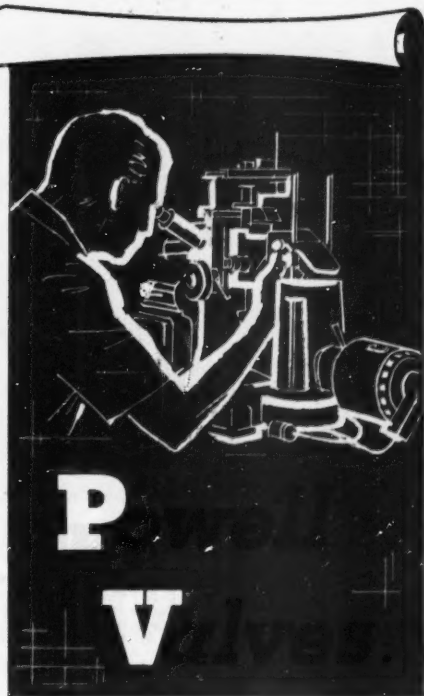
LEFT

STAINLESS STEEL O.S.&Y. GLOBE VALVE (Fig. 2475) for 150 pounds W.P. Plug-type disc is screwed into and pinned securely to a lock nut. Valve sizes are $\frac{1}{4}$ " to 3", inclusive.

RIGHT

STAINLESS STEEL O.S.&Y. GATE VALVE (Fig. 2453 G) for 150 pounds W.P. at 300 F. Interchangeable solid or double wedges. Bolted flanged bonnet, separable yoke arms.

These valves are available in a wide selection of corrosion resistant metals and alloys.



The life of a valve bears a certain relation to the life of the company that produces it. Powell has had a solid, oak-like growth for over a hundred years. That's only possible because The William Powell Company makes dependable valves.

Today, Powell Valves are proving their dependability in a greater variety of installations than any other valves in the world. And Powell is very likely the leader in research as well as development of special valves to overcome flow control problem situations.

All good reasons why PV, for Powell Valves, appears on more specifications year after year. The William Powell Company, Cincinnati 22, Ohio.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

..... 108th YEAR

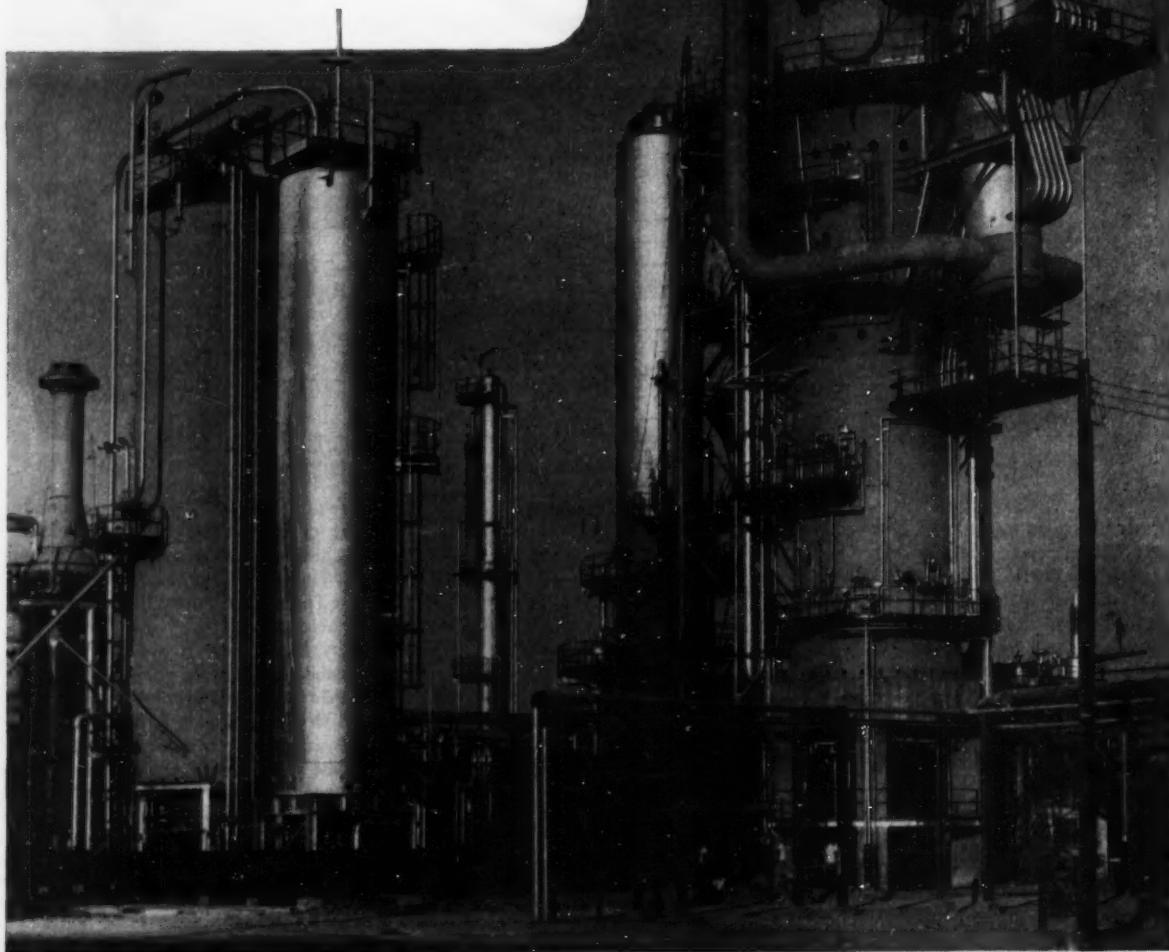


SHOP BUILT AND FIELD ERECTED PRESSURE VESSELS

CB&I's shop built and field erected pressure vessels for the process industries have proved their worth all over the world. The ortho-flow converter, fractionator and catalyst storage drums shown are typical of the special structures we build.

One feature is the CB&I Field Welding Supervisory Service. A welding expert is assigned to aid the Foreman on all heavy welded vessels.

Write our nearest office for information.



CHICAGO BRIDGE & IRON COMPANY

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Chicago 4.....2124 McCormick Bldg.
Cleveland 15.....2220 Midland Bldg.

Detroit 26.....1503 Lafayette Bldg.
Houston 2.....2103 C & I Bldg.
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Tulsa 3.....1623 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

WHAT TO LOOK FOR

When you buy a Bronze Valve

1 LOOK FOR DESIGN. Use the right valve for the right type of service at the right pressure. There is no such thing as an "all-purpose valve" . . . so don't try to make one valve do. In the complete Lunkenheimer line, there are 125 basic bronze valves — each ideal for a certain type of service. Get your Lunkenheimer Distributor's recommendations.



2 LOOK FOR OPERATING FEATURES, particularly those that make the valve longer-lasting and easier to use, such as the handwheel.



Lunkenheimer patented Non-Slip® Handwheel assures a firm, cool grip—makes it easy to close the valve tight, reducing wear and eliminating leakage. All Lunkenheimer Bronze Valves have the new Non-Slip Handwheel, along with many other exclusive operating features.



3 LOOK FOR A LONG-WEARING STEM, since stem-thread wear is one of the most common causes of valve failure.



Lunkenheimer Bronze Valves have Stemalloy® Stems — an exclusive silicon-bronze alloy which completely eliminates stem-thread failure. Not one of the millions of Stemalloy Stems now in service has ever been returned because of thread wear.

4 LOOK FOR CLOSE-GRAINED BRONZE, the mark of valve quality. Dense bronze not only increases the valve's strength, but makes it much more resistant to corrosion.



Lunkenheimer Bronze Valves are made of original Lunkenheimer alloys recognized by metallurgists as the highest-grade valve bronzes ever developed.

Remember—The Price Of A Lunkenheimer Valve Gets Smaller And Smaller And Smaller With Each Passing Year Of Dependable Service

ALL POPULAR SIZES of Lunkenheimer Bronze Valves are maintained in stock for prompt delivery. Write for new Circulars 534, 582, and 574 describing typical designs. The Lunkenheimer Co., Box 360X, Cincinnati 14, Ohio.



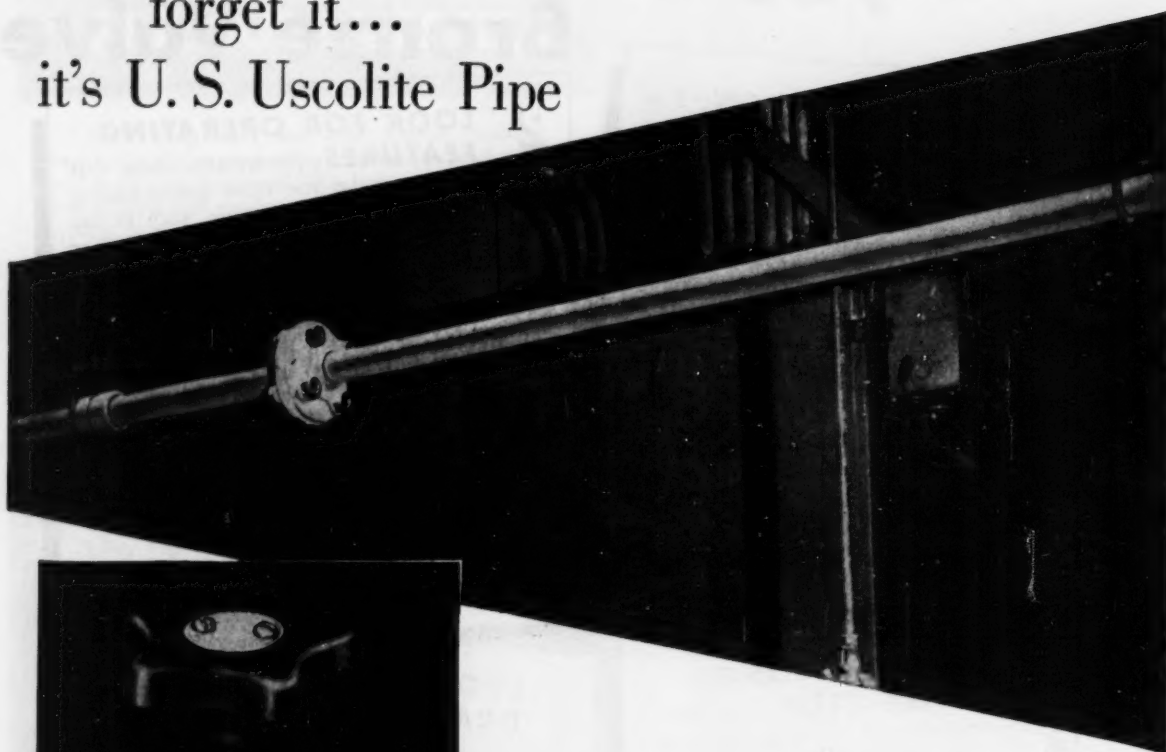
BRONZE • IRON • STEEL

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-154-15

Install it...
forget it...
it's U. S. Uscolite Pipe



USCOLITE DIAPHRAGM VALVE
Hills-McCanna (Saunders Patent)



*"U. S." Research perfects it
"U. S." Production builds it
U. S. Industry depends on it*

*No leakage, no corrosion,
no maintenance*

The Uscolite® pipe shown above is carrying alum in a wood fibre plant in the Far West. Leakage was a big problem in the piping previously used—and a man had to be in constant attendance to insure proper care of the line. With Uscolite, *leaks can't happen*. You simply install Uscolite and forget about it. What's more, Uscolite's smooth interior delivers material with less friction loss, and resists corrosive action of most chemicals.

Uscolite Pipe is made of plastic, by United States Rubber Company. Its light weight means it requires less support. It is easy to handle, won't break if dropped. Furnished in standard lengths, it can quickly be cut to length and threaded on the job. Also available are Uscolite fittings and Uscolite diaphragm valves, shown in inset.

Next time you need piping, we suggest you consult any of our 25 District Sales Offices, each staffed with engineers. They can show you how Uscolite can step up efficiency and reduce costs. Or write to address below.

UNITED STATES RUBBER COMPANY
MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes
Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

MIDWEST PIPING

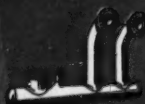
is shop-fabricated piping that saves manpower

The installation of Midwest Piping requires the minimum number of man hours because the difficult operations have been performed in the fabricating plant so that field erection time is reduced to a minimum. This makes possible earlier operation of the plant. Another reason for this time saving is that every subassembly is carefully checked before shipment to make sure it is dimensionally correct and accurate in alignment. The difficulty often encountered in securing skilled mechanics for field work makes this advantage of Midwest shop-fabricated Piping now more important than ever before.

From A Simple Bend



Or Welded Assembly



To Complete Piping Systems For Power Plant

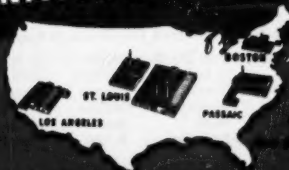


Or Process



Call On MIDWEST

MIDWEST
PIPING SERVICE IS
NATION-WIDE



PIPING FABRICATORS
AND CONTRACTORS

MIDWEST PIPING COMPANY, INC.

Head Office: 1910 South Second Street, St. Louis 8, Mo.
Plant Offices: Passaic, Penna., Los Angeles and Boston
Sales Offices: New York 1000 Church St. • Chicago 2—79 West Monroe St.
Los Angeles 28—288 Anderson St. • Houston 2—1812 Capital Ave.
Tulsa 2—224 Wright Way • Boston 27—126 First St.



Another reason why

Chase[®]

Cupro-Nickel Condenser Tubes last longer!

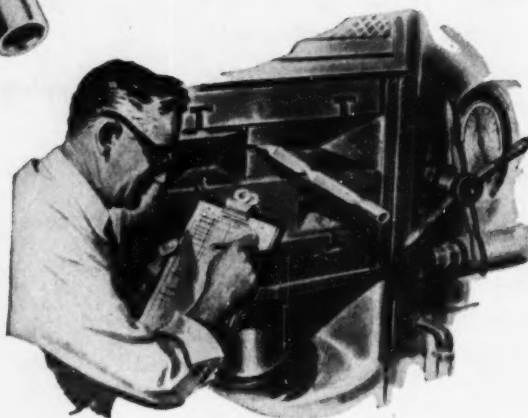
Yes, you can *count* on Chase Antimonial Admiralty Heat Exchanger Tubes to give you many years of satisfactory service.

Chase Heat Exchanger Tubes are rigidly controlled for quality during manufacture, and various tests are applied when the tube is finished. The flattening test mentioned below is a good example. Wall thickness, diameter, surface finish, concentricity and accuracy of length are carefully determined.

So, for Heat Exchanger tubes that last and last, *remember*: insist on Chase Antimonial Admiralty!

PUTTING THE SQUEEZE ON IMPERFECTIONS...

This Chase technician is performing a "flattening test" which is an indication of soundness and freedom from hidden defects. You are assured that tubes passing this test will satisfactorily withstand bending or end flaring.



Chase


BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

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Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver †	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston	Newark	Rochester †	(† sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	



**pick the stainless
that fits best**



When selecting stainless steel be sure you pick the correct type for your particular application. For some grades resist corrosion better . . . others have superior heat resistant properties. Some are easier to machine . . . still others can be more readily formed or welded.

In every case there is a grade of Crucible REZISTAL Stainless Steel that is best suited to the job. And to help our customers select the type that will provide the best service for the lowest cost, we make available all the design, metallurgical, fabricating and application data we have accumulated in our years of stainless steel experience with many different industries.

Our staff of field representatives brings you the benefit of our vast technical resources. And the quality of REZISTAL Stainless Steel sheets, strip, plates, bars, wire, forgings, castings and tubing produced in our modern integrated mills is unsurpassed in the industry. When you have an application for stainless, call Crucible.



Write for free copy of "Making the most of Stainless Steels in the Chemical Process Industries".

CRUCIBLE

first name in special purpose steels

54 years of *Fine* steelmaking

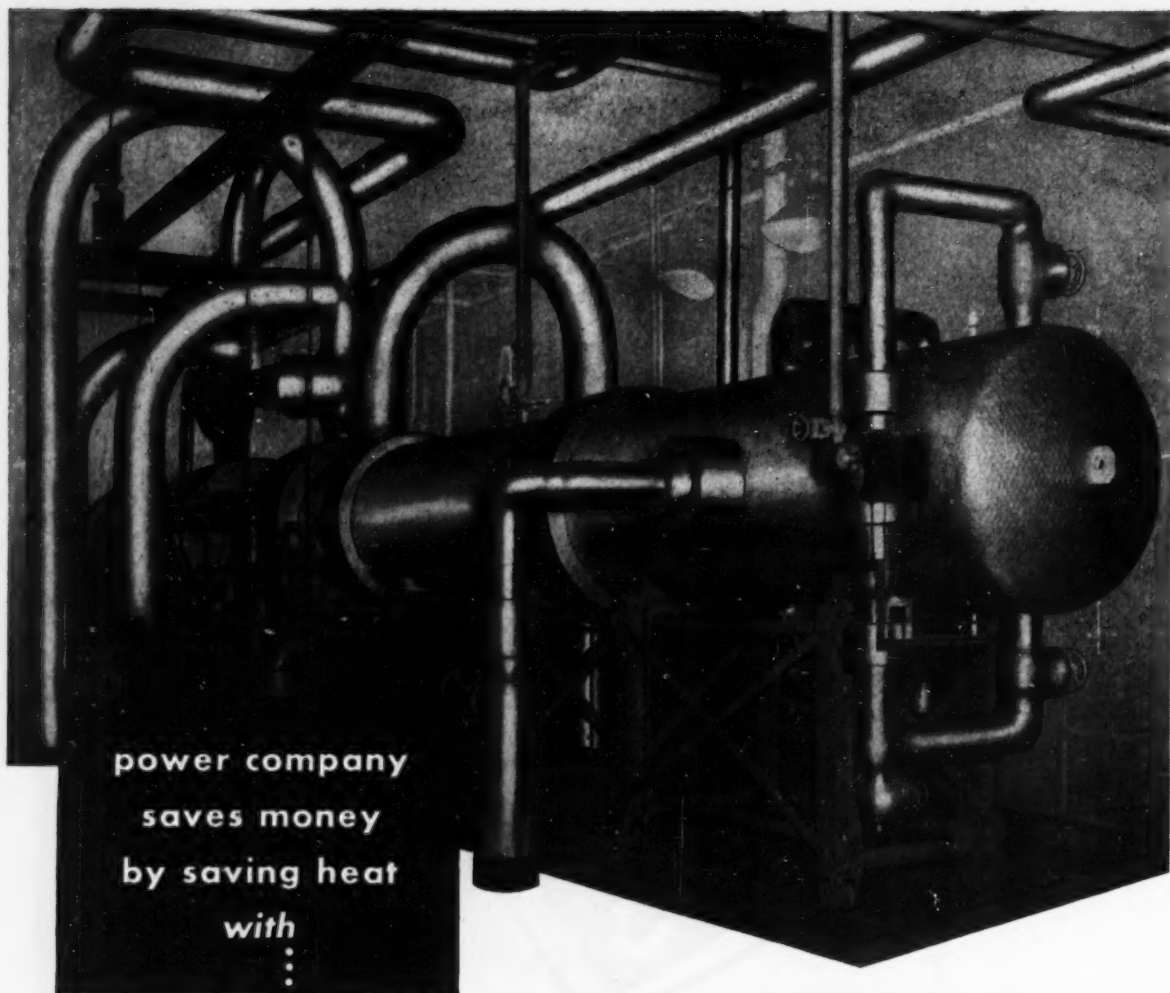
STAINLESS STEEL

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

CHEMICAL ENGINEERING—February 1954

333



power company
saves money
by saving heat
with
...

Steam heater insulated with "Featherweight" 85% Magnesia blocks and K&M asbestos cement. Meramec Power Plant, Union Electric Co., St. Louis, Mo. Insulation Contractor: Armstrong Cork Company

"Featherweight"® 85% MAGNESIA

In Union Electric Company's Meramec Power Plant, "Featherweight" 85% Magnesia was used to insulate the steam heater pictured above. Such an application is a typical one for dependable "Featherweight."

By itself this material (85% basic carbonate of Magnesia and asbestos fiber) is effective on piping and equipment with temperatures up to 600°F. Used with K&M Hy-Temp Insulation (diatomaceous silica), its range is extended to 1900°F.

Hy-Temp is applied directly to the hot surface, and "Featherweight" is used as the second layer. The two insulations are applied with staggered

vertical and horizontal joints—thus eliminating heat loss which occurs on single layer installations when the expansion of hot piping and equipment causes the joints to open.

This K&M combination insulation will last the life of the equipment it serves, will withstand moisture, alternate heating and cooling, wetting and drying. Both materials are supplied in various sizes and thicknesses.

Your K&M distributor is an experienced applicator who will gladly give you more information about these heat-saving, money-saving K&M insulations. Or write directly to us.

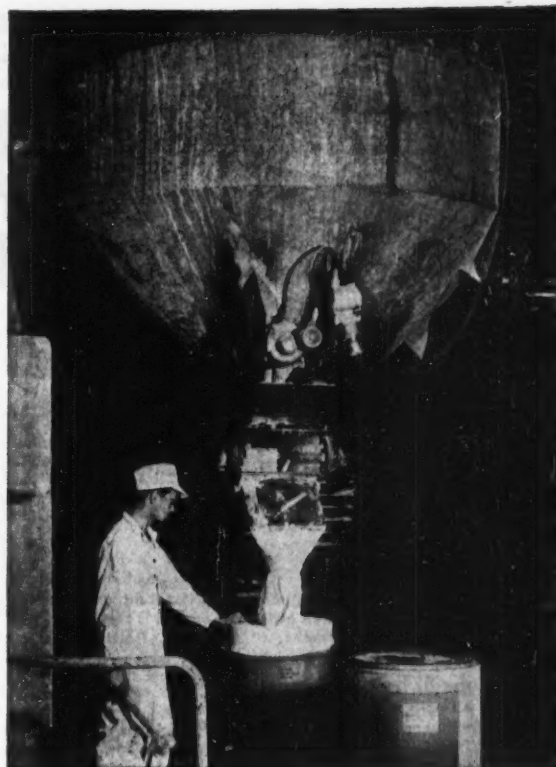
KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873



How Nickel Protects Saran Purity

...from wet polymer
to
finished plastic



Saran molding powder is mixed and made ready for shipment in nickel blenders designed and manufactured by Industrial Process Engineers, Newark, N. J. The 220 cu. ft. blenders have conical sections of solid nickel and nickel-lined cylindrical sections. Nickel was used because other metals have proved detrimental to the quality of the plastic.

As a finished product, saran is a wonderful material—it's inert to most oils and chemicals at room temperatures—has high tensile and impact strength.

But it must be handled gently in certain stages of production.

The manufacturers of the saran powder found that out in the processing .

As a wet polymer it is sensitive to many metals and may turn yellow when it comes in contact with them. The chemical company which makes the powder found a solution to this problem in specially designed blenders made of nickel.

Then the manufacturers of saran-molded products discovered that certain metals catalyze the decomposition of the material. They too

found that they could guard against this and protect the purity of the hot plastic by using nickel and Inco Nickel Alloys for all parts the plastic came in contact with.

And when the extruders found that the hot saran was corroding their equipment, they turned to tough Duranickel for cylinder liners, screws, dies and other parts.

Perhaps you, too, have a problem of purity-protection or corrosion. If so, why don't you write Inco's Corrosion Engineering Section and tell them your problem. They'll be glad to help you.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Inco Nickel Alloys

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL
"S"® MONEL • INCONEL® • INCONEL "X"®
INCONEL "W"® • INCOLOY® • NIMONIC® ALLOYS • NICKEL
LOW CARBON NICKEL • DURANICKEL®



RHEINHUETTE

type RE-Sa

TRUE SELF-PRIMING CHEMICAL PUMPS

without auxiliary priming tanks

OUR COMPLETE LINE INCLUDES:

Centrifugal Acid Pumps without Packing • Centrifugal Acid Pumps with Relieved Packing Gland • Self Priming Acid Pumps • Screw Impeller Acid Pumps • Centrifugal Pumps with Full-Way Tubular Impeller • Acid and Sewage Sump Pumps • Cement Slurry Centrifugal Pumps.

Our engineers and metallurgical experts—some of the world's most experienced—are ready to assist you in the economical, permanent solution of your pumping and valving problems.

DESIGNED SPECIFICALLY FOR THE EMPTYING OF VATS, TANK CARS, ACID CONTAINERS AND DEEP SUBTERRANEAN TANKS

Consider the following outstanding advantages of the RE-Sa Chemical Pump before planning replacement or installation of a new chemical pump:

1. SELF-PRIMING

Rheinhuette RE-Sa draws liquids over considerable heights, yet requires manual priming only at the time of initial installation, using the acid to be delivered. No priming of the suction line is required, nor is it necessary to utilize a suction strainer or foot valve. The Rheinhuette RE-Sa performs equally well with gaseous acids.

2. HIGHLY CORROSION-RESISTANT

All parts coming into contact with acids are made of alloys best suited to withstand corrosion. For example: Special Grey Cast Iron ("Perlite"), Silicon Iron, Chrome, Chrome-Nickel-Moly, etc. Castings, Hard Lead, Bronze, Silumin, (Silicon Aluminum Alloy) and Rubber-lined.

3. ADAPTABLE

The Rheinhuette RE-Sa can easily be made portable for use at various installation points throughout the plant.

4. TIME—SAVING

Rheinhuette RE-Sa is simple to operate... free of excessive vibration... and requires little, if any, regular maintenance. Normally equipped with flanges. Hose connectors for the 1½" and 2" sizes furnished on request.



ALL RHEINHUETTE PUMPS ARE CONSTRUCTED TO AMERICAN STANDARDS AND YOUR SPECIFIC NEEDS

CENTRIFUGAL PUMPS • VALVES
FITTINGS FOR ACIDS AND CAUSTICS



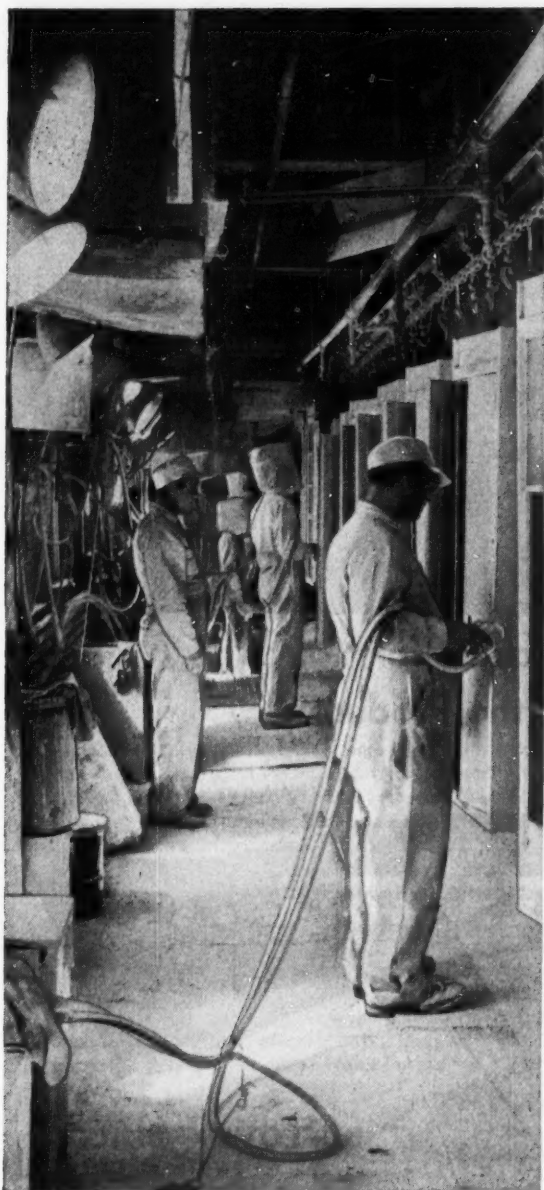
RHEINHUETTE (Wiesbaden-Blebrich, Germany)

Write Today for Inquiry Forms and Literature

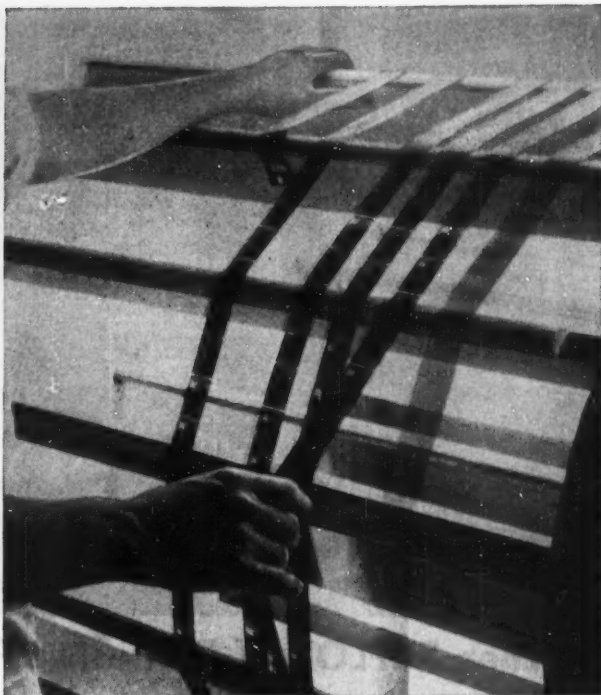
NEUMANN & WELCHMAN

Sole U. S. Representatives:

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Paint, Varnish and Lacquer



Photographic Films



Heavy-duty Motor Oils (additives)

Success in the process! They all rely on



for a
complete line
of high quality
petroleum chemicals

PETROLEUM

PARANOX
PARATONE
PARAFLOW
PARAPOID
PARADYNE
PARATAC
PETROHOL
Methyl Ethyl Ketone
Dewaxing Aid
Ethyl Ether
Isopropyl Ether
Reference Fuels

SURFACE COATING

PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Secondary Butyl Alcohol
Secondary Butyl Acetate
Isopropyl Acetate
Acetone
Methyl Ethyl Ketone
Ethyl Ether
Isopropyl Ether
Dicyclopentadiene
Naphthenic Acids
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol

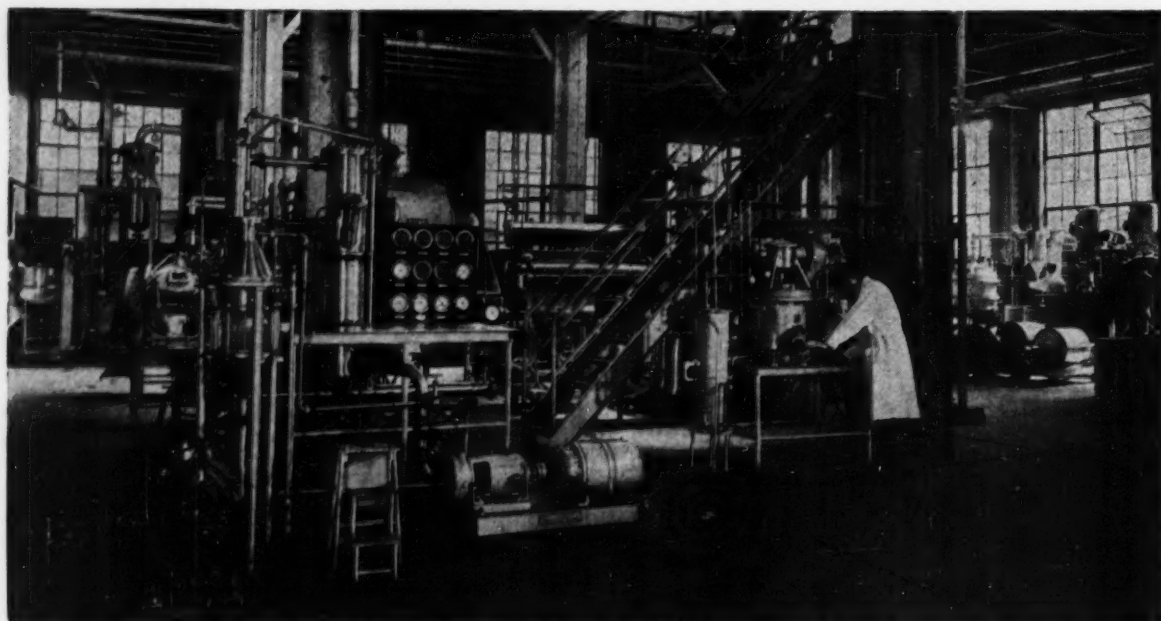
CHEMICAL

PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Tridecyl Alcohol
Dicyclopentadiene
Isoprene
Butadiene
Ethyl Ether
Isopropyl Ether
Tetrapropylene
Tripropylene
Aromatic Tars
Benzene
Acetone
Methyl Ethyl Ketone

34 successful years of leadership in serving industry

To get proved results rely on a leader. The Enjay Company offers a wide variety of chemicals, backed up by 34 years of pioneering, research and experience. More and more industries in many different fields are depending on Enjay for successful results. Be sure you specify Enjay for *your* chemical needs.

ENJAY CO., INC. • 15 West 51st Street, New York 19, N. Y.



When BUFLOVAK Pre-tests a Process for You... There's No Guesswork About the Product!

In the development of new and better processes, BUFLOVAK can help you save time and money by processing your product in full semi-plant scale.

BUFLOVAK operates this testing laboratory to assist you in the solution of processing problems and development of new methods and equipment. Practical research is used to find better methods of drying, evaporating and processing chemicals and food products.

There's a wealth of valuable experience gained through completing thousands of processing tests to be shared with you.

May we send you a copy of "The Answers to 6993 Processing Problems."

TESTS TELL...

BUFLOVAK BUILDS

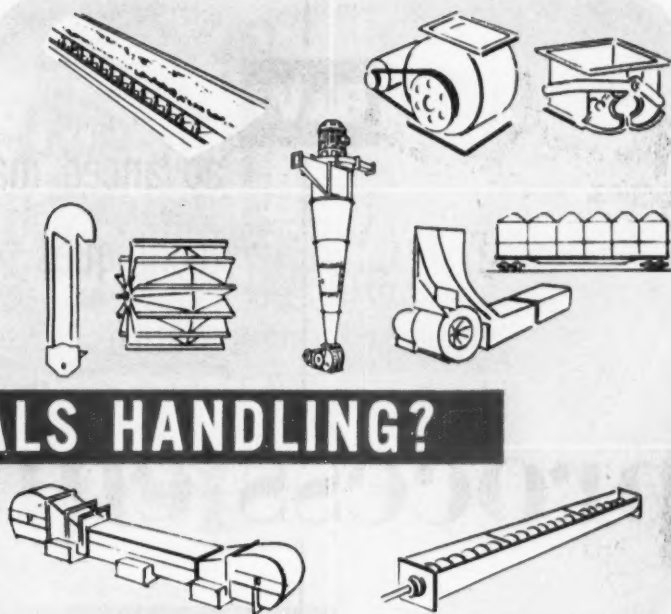
Evaporators	Pilot Plant
Low Temperature	Atmospheric
By-Product Recovery	Processing Kettles
Chemical	Mixers
Food Product	Impregnators
Crystallization	Dopp Kettles
Dryers	Solvent Recovery &
Vacuum Double Drum	Distillation
Vacuum Rotary	Equipment

BLAW-KNOX

BLAW-KNOX COMPANY
BUFLOVAK EQUIPMENT DIVISION
 1549 FILLMORE AVE.
BUFFALO 11, N.Y.

which method
can save you
the most in

BULK MATERIALS HANDLING?



AIR

Outstanding examples of the great savings made possible by pneumatic conveying systems are found in the Sprout-Waldron Pneu-Vac. This modern, negative-pressure system handles granular, pulverized, and flaky materials without passing them through the fan. Mechanical friction and exterior dusting are eliminated. The unit is self-cleaning. It cools, heats, aerates, or dries. There are few moving parts. As a result, Pneu-Vac pays in many ways—

99.96% material recovery...no handling losses...increased production...greater safety...low maintenance...no product intercontamination...no fan wear...elimination of exterior dust...improved working conditions...small space requirements.

zontally and up inclines. Sprout-Waldron offers sound guidance on belt conveying applications and a full line of pulleys...and is the exclusive manufacturer of the famous Belt-Saver Pulley that lengthens belt life up to 400%.

BUCKET

Bucket elevators use less power, are usually lowest in first cost and maintenance expense. However, they cannot be made as self-cleaning and contamination-proof as other materials handling systems. Sprout-Waldron offers bucket elevators in bucket sizes from 3" x 3" to 30" x 16"...wood, stainless, carbon steel, and aluminum...chain or belt, high speed or conventional.

SCREW

Screw conveyors offer advantages for two types of jobs: (1) The straight-line horizontal conveying of a wide range of bulk materials over moderate distances. (2) The vertical lifting of non-fusing materials to limited heights. Sprout-Waldron vertical and horizontal screw conveyors are extremely low in maintenance and moderate in power requirements. Available in conventional helicoid, continuous sectional, and sectional types.

FEEDERS

To provide the greatest possible savings in applications calling for rotary vane feeders, Sprout-Waldron offers you three advantages: (1) The most extensive line to be found anywhere. (2) Years of experience gained through pioneering in this specialized field. (3) The simplest, sturdiest and easiest-to-maintain feeders available.

Whichever type of conveying equipment fits your needs, you'll get greatest savings with a Sprout-Waldron installation. Sprout-Waldron solves your problems with a vast background of experience, complete lines of equipment and unique "adaptioneering" methods. Let us advise you without cost or obligation. Please write for details.

BELT

Belt conveyors are unequalled in speed and economy for long-distance conveying of bulk materials hori-

YOUR INVESTMENT PROTECTED
Our 88 years of service to industry is good assurance that you can obtain parts and service for the life of your Sprout-Waldron equipment.



SPROUT-WALDRON

Manufacturing Engineers Since 1866

Equipment for SIZE REDUCTION · MIXING & BLENDING · PELLETING & CUBING · BULK MATERIALS HANDLING · PRODUCT CLASSIFICATION

Facilities for fabricating, machining, custom founding, woodworking, laboratory testing
15 LOGAN STREET · MUNCY, PA.

B&W

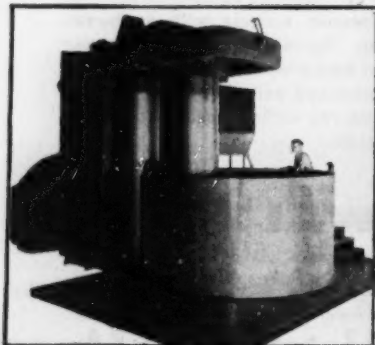
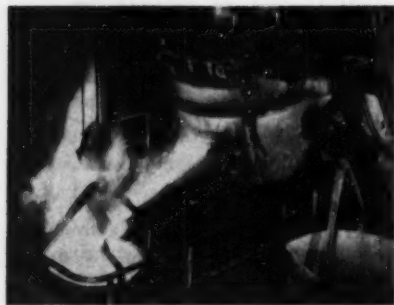
advanced manufacturing
techniques
assure

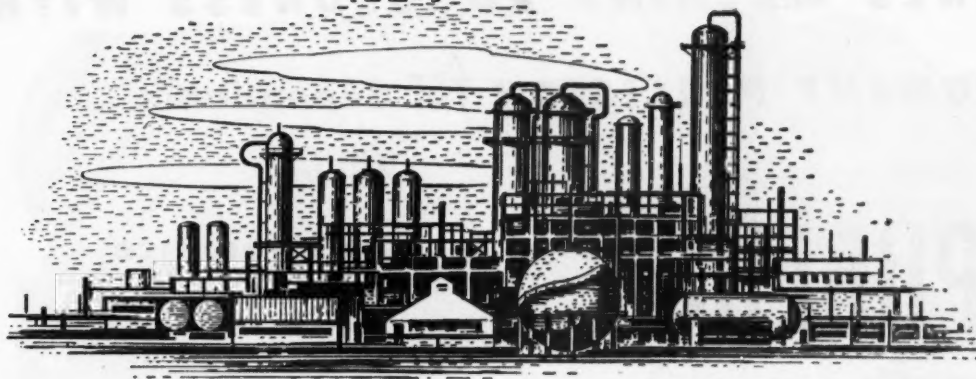
process equipment

Uncompromising attention to detail during every manufacturing operation is the user's guarantee of satisfaction with B&W Process Equipment.

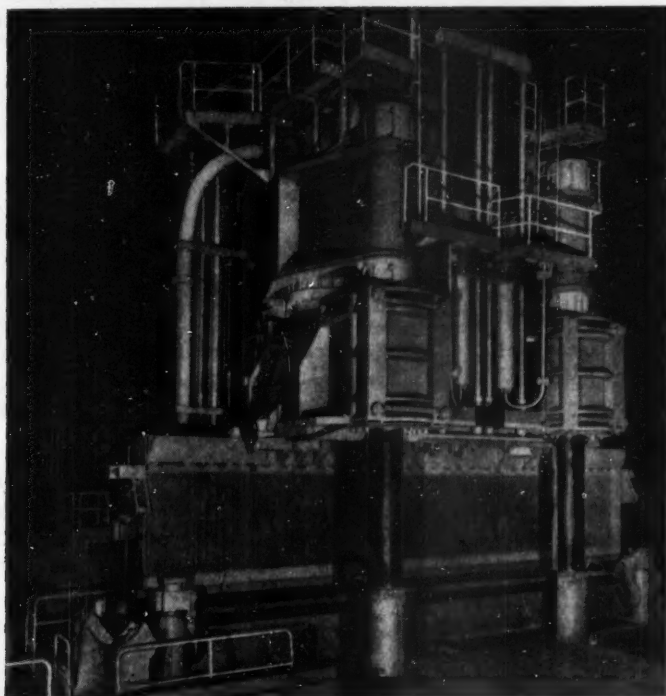
Many of the advanced production and testing techniques used, in casting, forming, machining, welding and stress relieving, require specially designed equipment. Much of this equipment was originally developed by B&W.

Intensive research and development, aided by long experience and first-rate facilities, have earned for B&W Process Equipment a fine reputation across the nation and abroad. The Babcock & Wilcox Company, Process Equipment Dept., Barberton, Ohio.





built to last



New hydraulic press, installed at B&W's Barberton, Ohio, works, is used to form extra heavy plate and to pierce billets. It is the largest of its kind, and has a capacity of 6500 tons plus.

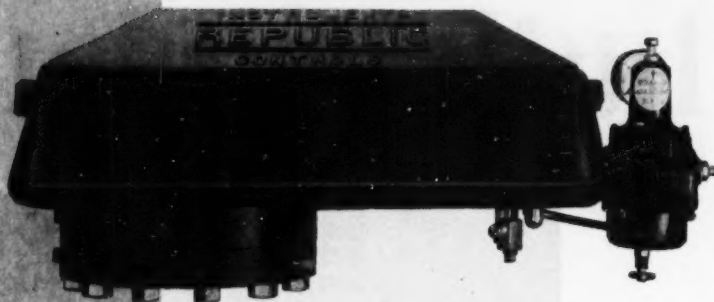


COMBINES MACHINE RUGGEDNESS WITH INSTRUMENT PRECISION for dependable

low
maintenance
metering

REPUBLIC

pneumatic
transmitter
for measuring
FLOW, PRESSURE,
LEVEL or
DENSITY...



Machine dependability with instrument accuracy and sensitivity! Think what this combination of features can mean in your plant—less maintenance, longer life for lowest "long run" cost, continuous accurate operation.

You get all of these benefits and more with the Republic Pneumatic Transmitter. Force-balance operation permits the use of strong rugged parts with no sacrifice in accuracy or sensitivity. Gives exceptional overrange protection.

Housed in a durable metal case, the transmitter may be adjusted for mounting at any angle, indoors or out. Its accuracy is not affected by changes in ambient temperature vibration, nor-

mal changes in supply air pressure or inaccurate leveling. Uses no mercury or purge pots. Can be used with very viscous fluids.

The Republic transmitter isolates fluids to a measuring chamber which may be supplied in a variety of corrosion resistant materials. It sends an air pressure proportional to fluid flow, pressure, level or density to reading instruments or for actuation of an automatic controller.

Republic Pneumatic Transmitters are proving their superiority in hundreds of chemical and oil field applications. Investigate their advantages for you—write for your free copy of 36 page Data Book No. 1004.

SPECIFICATIONS:

ACCURACY— $\frac{1}{2}\%$ of maximum range guaranteed for standard models.

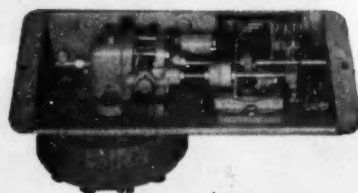
DIFFERENTIAL RANGES—Any desired span between 0-0.6" H₂O and 0-750 psi at operating pressures of 15 psig to 2000 psig.

PRESSURE RANGES—Any desired span between 0-1" H₂O and 0-2000 psig.

LEVEL RANGES—to meet almost any application.

DENSITY RANGES—0.15 sp. gravity spread for 3 to 15 psig output pressure from any base density.

Extremely wide range change is possible without change of parts. Ranges may be easily changed, suppressed, compounded or reversed.



● **EASILY SERVICED** Cover can be completely removed for access to all range adjustments and replaceable parts. No special tools required.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois



Above: Liquid latex is hauled in this 3,500-gallon Fruehauf Tank-Trailer, which is owned by the American Foam Rubber Corporation, Burlington, New Jersey, manufacturer of Mirafoam latex pillows and mattresses. Left: Loading the finished pillows in American's closed Fruehauf van.

IN ALL STAGES OF SHIPPING FRUEHAUFS CUT COSTS!

MANY MANUFACTURERS in the chemical field now employ Fruehauf Trailers—both tanks and vans—for procurement of supplies and delivery of their products, because Trailers *cut transportation costs*. The American Foam Rubber Corporation, for example, ships both liquid latex and finished foam rubber pillows in Fruehauf Trailers.

The way to judge a Trailer is by its economy of operation, its length of service, and its resale value. Fruehaufs, because of their advanced engineering, exclusive features, and sturdy construction, excel on all counts. And, note that there is no limit to the number or types of liquid chemicals that can be hauled safely in Fruehauf Tank-Trailers, for there is a standard or special Fruehauf for every liquid product.

To find out exactly how much Fruehaufs can save in your business, ask your nearest Factory Branch for a free "Transportation Cost Analysis." Call today — and *save now*.

World's Largest Builder of Truck-Trailers

FRUEHAUF TRAILER COMPANY

Detroit 32, Michigan

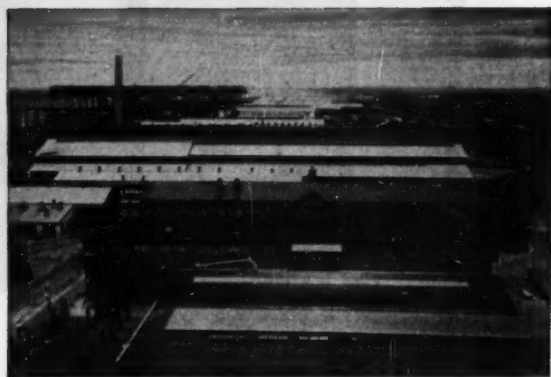
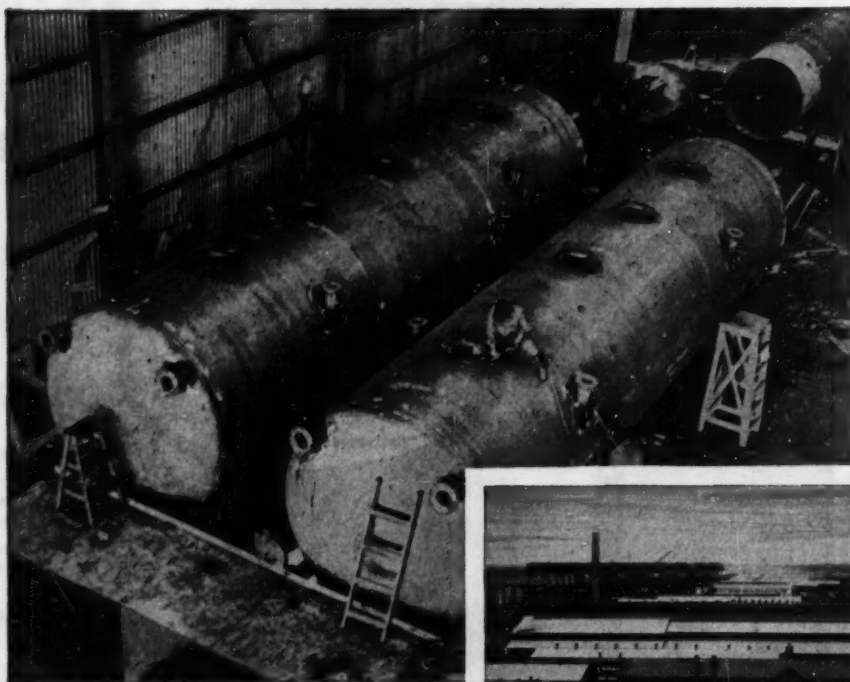


SULPHURIC ACID TRANSPORTS

CAUSTIC SODA TRAILERS

LIQUID CARBON DIOXIDE UNITS

PLASKON TANK-TRAILERS



A half mile of pressure vessels

A Mile of Shops — Each shop is devoted to a special type of heavy production. Included are complete Machine Shops, casting, forging and other facilities which offer all of the advantages of the execution of the complete job.

These are two of seventy — over $\frac{1}{2}$ mile — of 38½-foot vacuum tank casings built to meet the quality requirements of a well-known chemical maker.

The buyer also benefits from many savings made possible by Newport News extensive heavy fabrication equipment and the sixty years experience in using it.

Do you plan installations of heavy production equipment? You can command the services of Newport News for weldments of

corrosion-resistant, alloy and clad metals in almost any size or shape, plus the required engineering background and complete welding and stress-relieving skills.

It will pay you to get the facts, shown in *Facilities and Products*. As you glance at its photos and brief captions, you'll see why Newport News can turn out — at low cost — specialized heavy equipment for chemical plants.

Send for *Facilities and Products* — free — today.

Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia



**AIR & GAS
COMPRESSORS**

Assure Constant Efficiency

**Same Pressures Maintained
YEAR after YEAR Without Loss
of Volume**

YOU are assured of constant operating efficiency with *Ro-Flo* air and gas compressors because they are simple in construction with few parts to wear. After years of continuous operation, under normal conditions, *Ro-Flo* units have maintained constant volume output without loss of pressure, and have shown no visible signs of wear.

Today, *Ro-Flo* compressors play an important role in almost all chemical manufacturing. They are compact, self-contained units that provide continuous pulsation-free flow. And their relatively high speed rotary action eliminates vibration and shock — reduces foundation needs to a minimum.

Ro-Flo compressors are built in capacities from 40 to 3200 cfm at pressures from 5 to 40 psig. And they are only one of five separate types of air and gas handling units manufactured by Allis-Chalmers.

For detailed information on an air or gas handling unit to fit your particular need, contact your nearest A-C sales office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4140

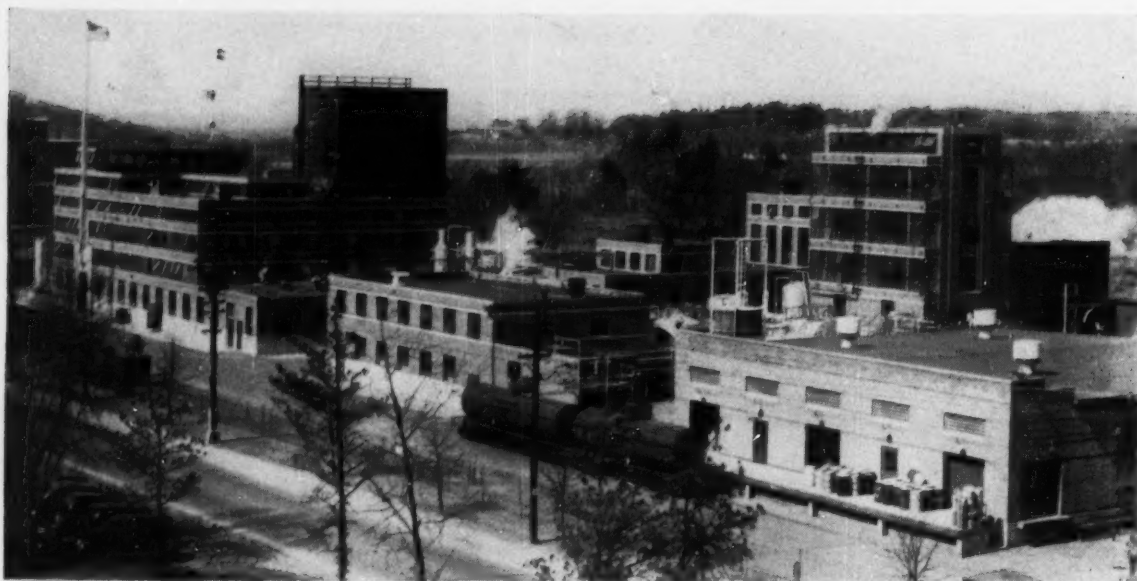
Ro-Flo is an Allis-Chalmers trademark.

USED IN NEW ACRYLIC PROCESS

In a new acrylic process recently put on stream by the Rohm & Haas Company, Houston, Texas, a *Ro-Flo* gas compressor is handling a composite of hydrogen obtained from a low temperature distillation mixture of carbon monoxide and hydrogen. The new R & H process reduces the costs of methyl and ethyl acrylates — basic materials for synthetic organic chemicals.

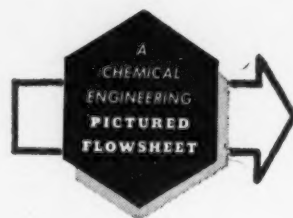
ALLIS-CHALMERS





THE SHAWINIGAN RESINS PLANT for production of polyvinyl butyral resin has recently undergone an expansion.

Polyvinyl Butyral



Reacting PVA with butyraldehyde, Shawinigan Resins Corp. makes polyvinyl butyral resin—the interlayer in safety glass. Demand is increasing.

Shawinigan Resins Corp., Springfield, Mass., a subsidiary of Shawinigan Products and Monsanto, recently expanded its facilities for making polyvinyl butyral resin. (See page 122.) Behind this expansion is a steadily increasing demand and a promising future for this material—the “safety” interlayer in laminated safety glass.

By far, the largest user of the resin is the automotive industry. However, safety glass is finding additional applications in railroad cars, television sets and military aircraft.

In the Shawinigan process, polymerized vinyl acetate is hydrolyzed to the alcohol. An acetalization reaction—where an aldehyde (butyraldehyde, C_4H_7CHO) and the alcohol react in the presence of an acid—produces polyvinyl butyraldehyde.

► **How It's Made**—Vinyl acetate monomer is received in tank cars and stored in large steel tanks. First step in the process is the polymerization reaction. This is a moderate-temperature, atmospheric-pressure reaction. It is carried out either in solution with a suitable solvent or in an aqueous suspension. A peroxide-type catalyst is used to speed up the reaction.

After polymerization the polyvinyl acetate is dissolved in ethyl alcohol to form a viscous varnish. This is pumped to an agitated vessel where hydrolysis to polyvinyl alcohol takes place in the presence of a strong mineral acid catalyst, such as sulfuric acid.

A continuous, solid bowl centrifugal separates the polyvinyl alcohol from the mother liquors. Liquors pass to recovery units—byproduct ethyl acetate is recovered and unreacted ethyl alcohol concentrated and recycled.

► **Acetal Reaction**—PVA from the centrifugal is reslurried with fresh alcohol in the acetal reactor and butyraldehyde added. This reaction also takes place in the presence of a strong mineral acid catalyst. After acetalization the varnish is “polished” in a plate-and-frame filter press. Filter medium is a high-grade wool felt backed up by stainless steel screens.

Filtered varnish goes to a kettle where the polyvinyl butyral is precipitated. The varnish is agitated with the proper amount of water to form particles of an essentially uniform size. Weak liquors are drained from the resin and concentrated in the recovery stills.

Resin is then washed with water, centrifuged and the solids run into a rotary warm-air dryer. Cocurrent flow of air and resin is used. This places the high humidity air at the dryer discharge and prevents the accumulation of static charges on the particles.

Dried resin is air-conveyed to a sifter and packed for shipment.

No Seat Leakage Through This Valve ...on Hot Wax Service, for instance



THE INSTALLATION

In the wax unit of a leading Gulf Coast lube oil plant, with Crane Steel Gate Valves in hot wax lines to slabbing machines.

THE CASE HISTORY

The steel valves originally installed here were hindering maximum wax production. The chilling cycle was slow—rejects for remelting were high. The trouble was that the shutoff valves were leaking, and hot wax was getting into the presses during the chilling cycle. Yet the valves were comparatively new.

There's been no such trouble since Crane No. 47X, 150-Pound Gates were installed more than 2 years ago. Their Crane Exelloy trim, suited for temperatures up to 1000 deg. F. keeps giving a tight shutoff on the hot wax, month after month, with easy operation. And they've done so with but routine attention, ever since installed. Better quality is always the bigger value, as every thrifty valve buyer knows.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

CHEMICAL ENGINEERING—February 1954

VALVE SERVICE RATINGS

SUITABILITY:

Best for the job

FEATURES:

Outstanding Exelloy trim

MAINTENANCE COST:

Routine care only

SERVICE LIFE:

*Good as new—
after more than 2 yrs.*

OPERATING RESULT:

*No production lost
to valve trouble*

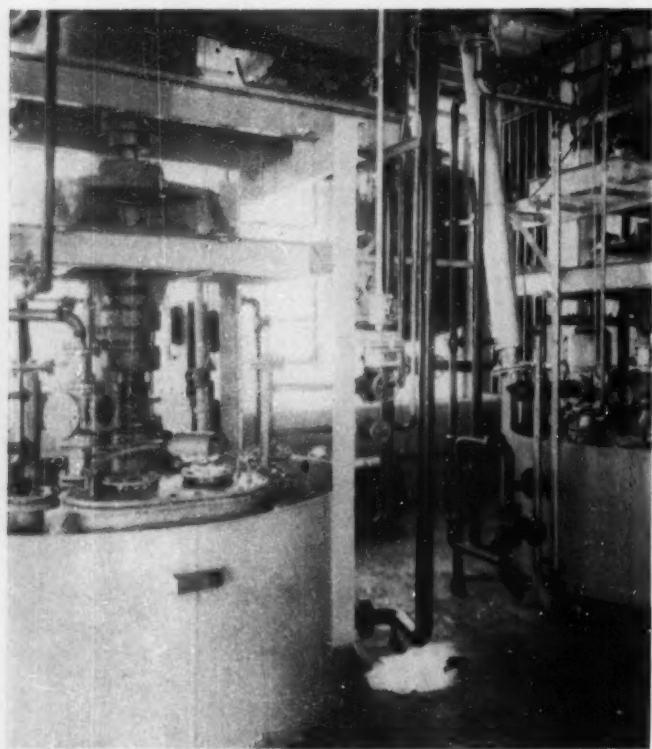
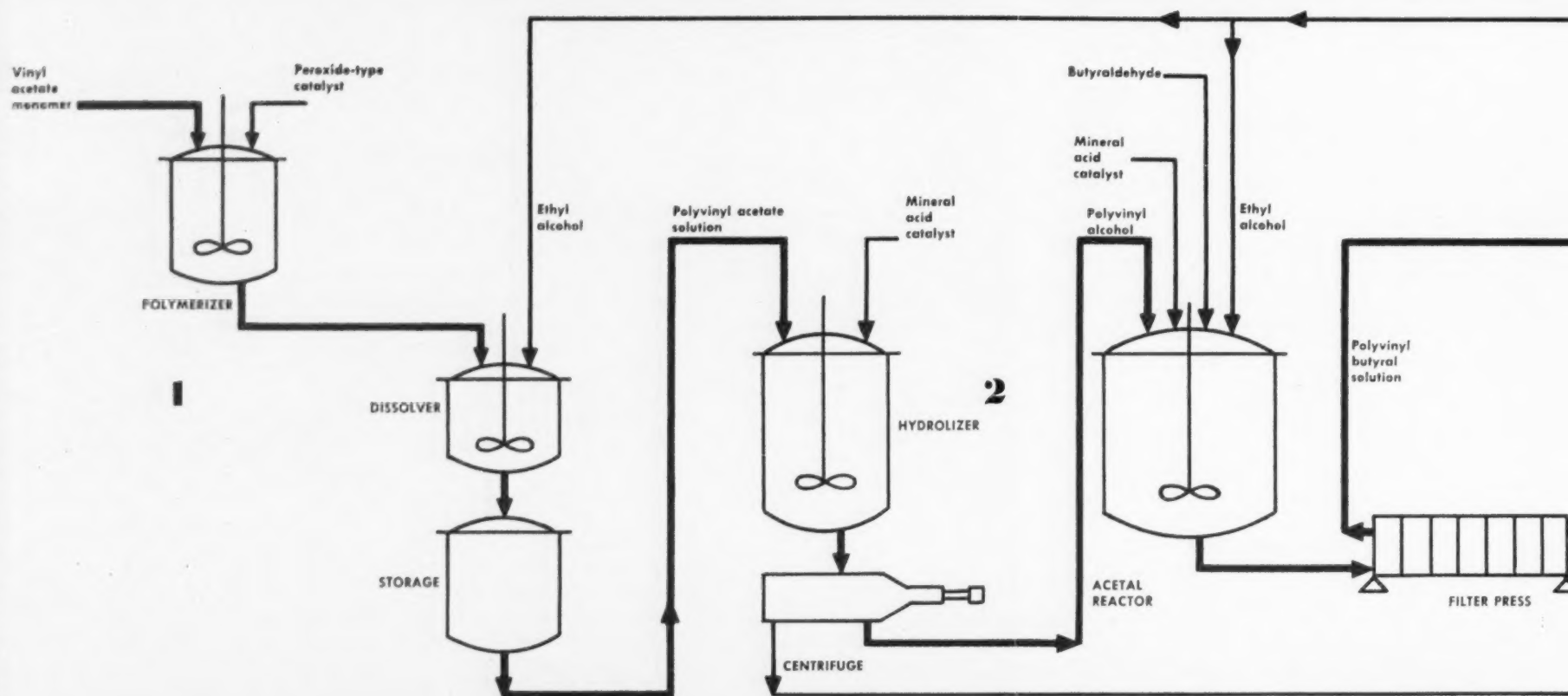
AVAILABILITY:

Regular Catalog item—No. 47X

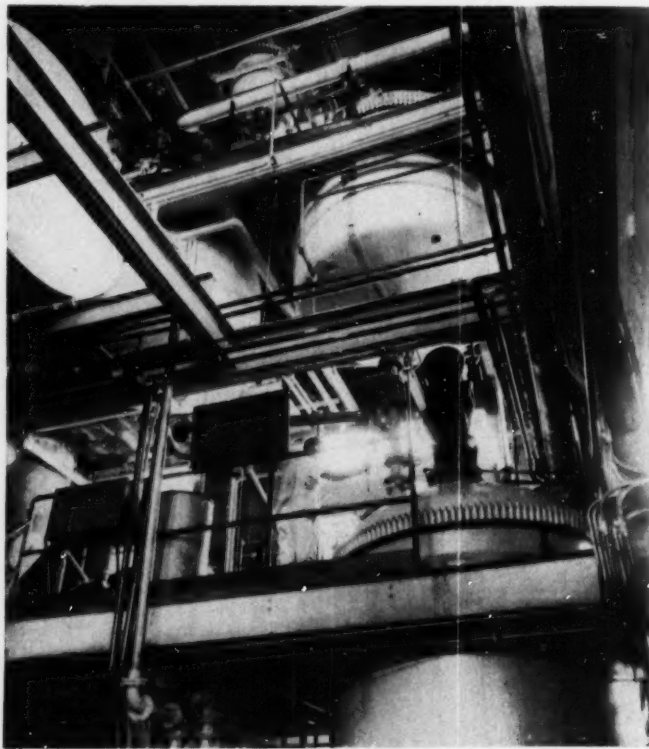
THE VALVE

Workhorse of the petroleum industry—Crane 150-Pound Steel Gates—with exceptional performance assured by Crane quality design—Crane pioneering in steel casting—and the high adaptability of Crane Exelloy trim for most petroleum services. Sizes 2 to 24 in.; screwed, flanged, welding ends. See your Crane Catalog or your Crane Representative.

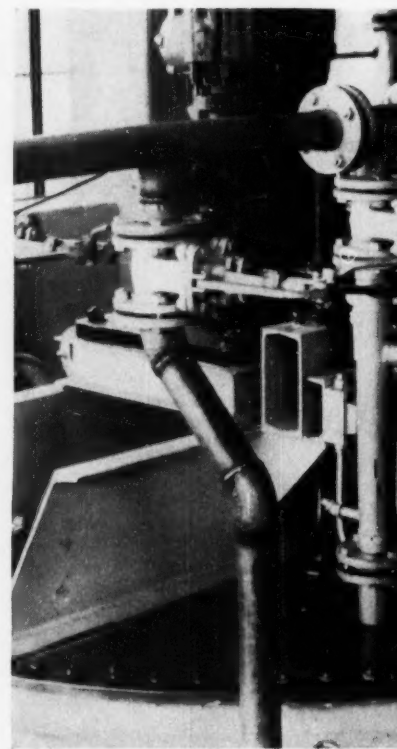




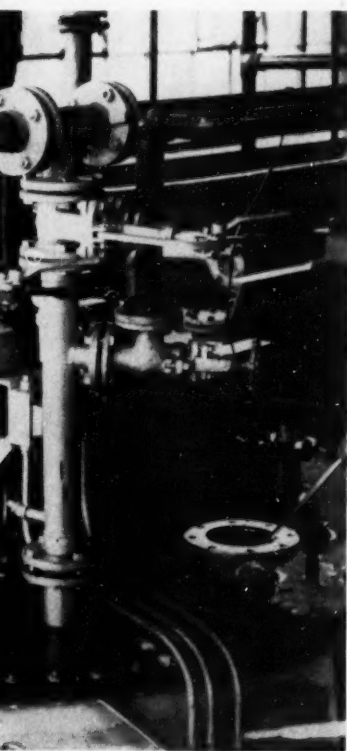
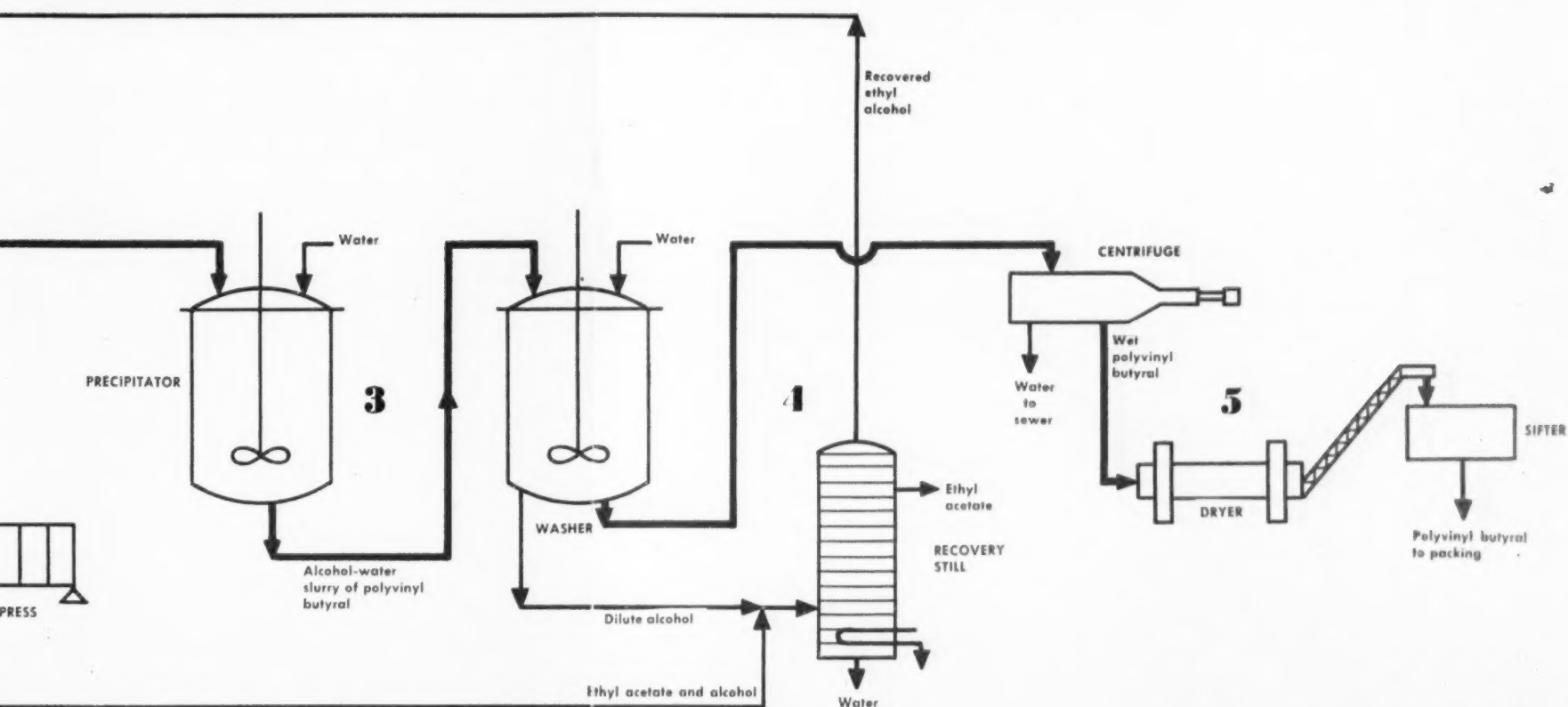
1 POLYMERIZERS turn vinyl acetate monomer into polyvinyl acetate.



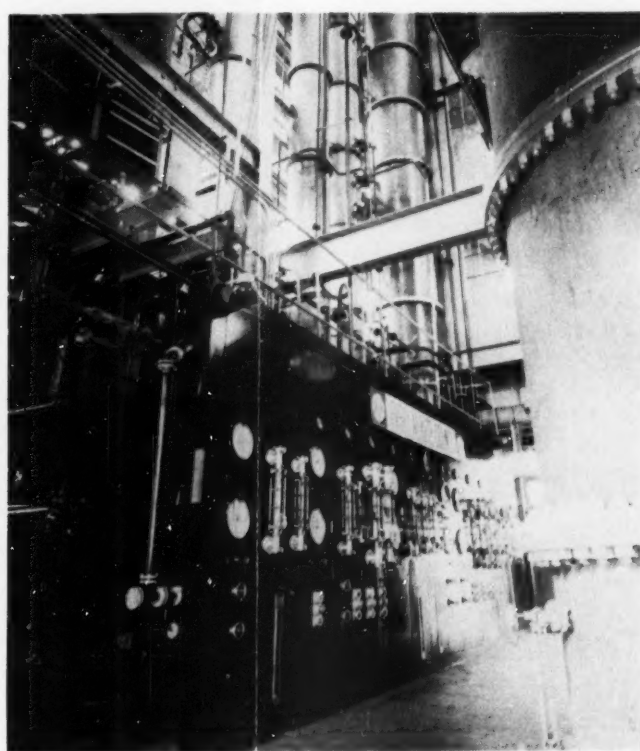
2 HYDROLYSIS in the upper tank. Acetalization in the lower tank.



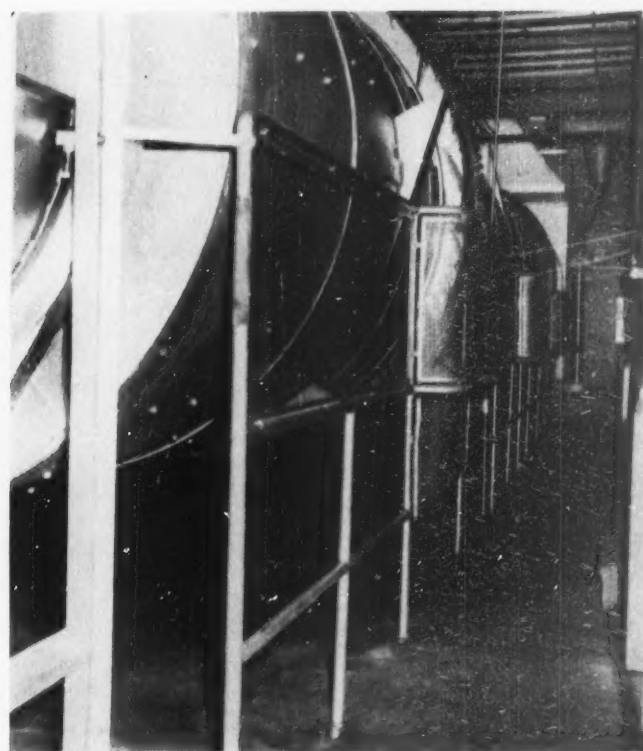
3 PRECIPITATOR produces an alcohol-water solution.



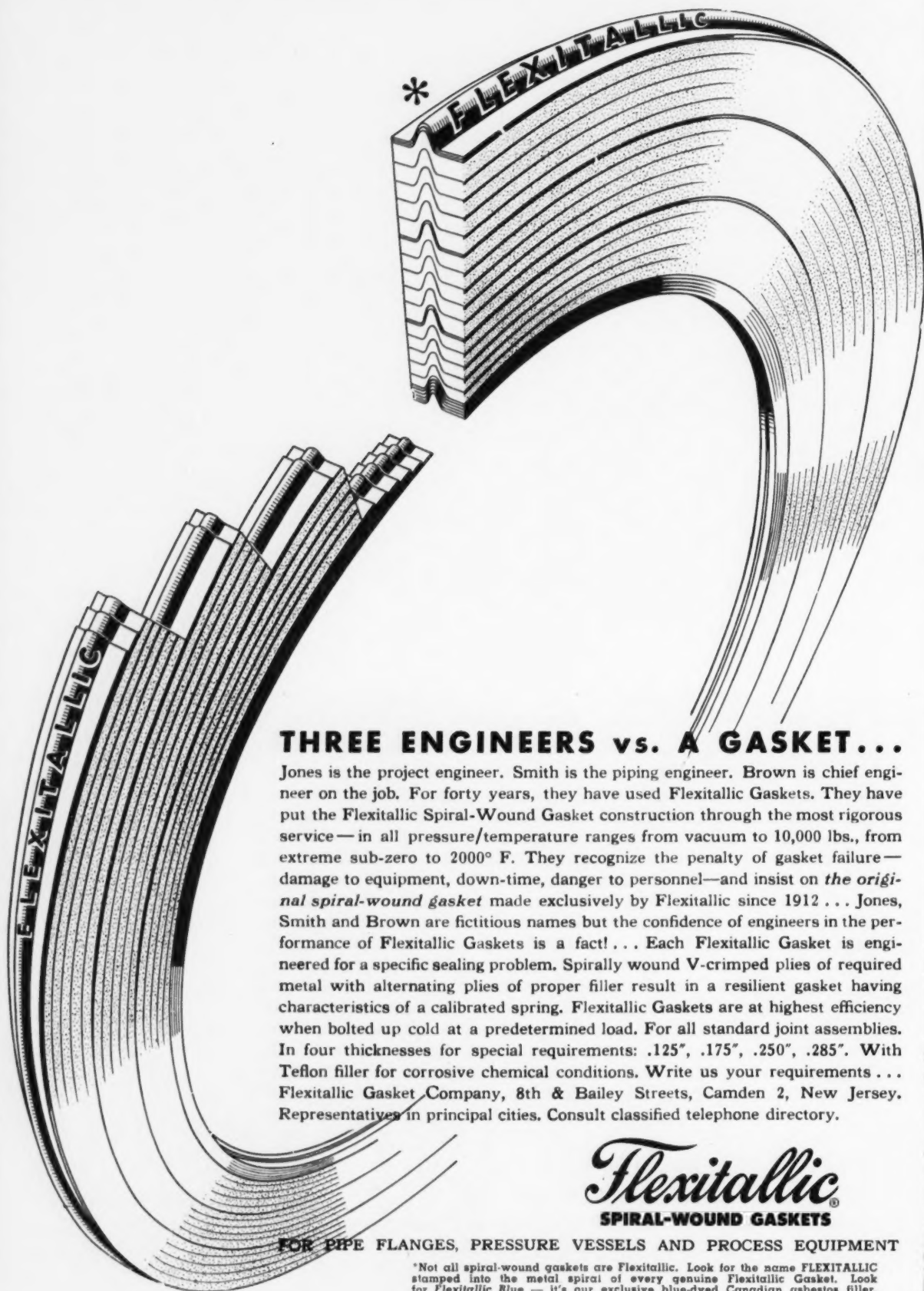
Alcohol-water slurry of the resin.



4 RECOVERY STILLS recover ethyl alcohol and ethyl acetate.



5 ROTARY DRIER removes moisture from the wet resin product.



THREE ENGINEERS vs. A GASKET...

Jones is the project engineer. Smith is the piping engineer. Brown is chief engineer on the job. For forty years, they have used Flexitallic Gaskets. They have put the Flexitallic Spiral-Wound Gasket construction through the most rigorous service—in all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. They recognize the penalty of gasket failure—damage to equipment, down-time, danger to personnel—and insist on *the original spiral-wound gasket* made exclusively by Flexitallic since 1912... Jones, Smith and Brown are fictitious names but the confidence of engineers in the performance of Flexitallic Gaskets is a fact!... Each Flexitallic Gasket is engineered for a specific sealing problem. Spirally wound V-cripped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements... Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult classified telephone directory.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for Flexitallic Blue — it's our exclusive blue-dyed Canadian asbestos filler.

No Seat Leakage Through This Valve ...on Hot Wax Service, for instance

THE INSTALLATION

In the wax unit of a leading Gulf Coast lube oil plant, with Crane Steel Gate Valves in hot wax lines to slabbing machines.

THE CASE HISTORY

The steel valves originally installed here were hindering maximum wax production. The chilling cycle was slow—rejects for remelting were high. The trouble was that the shutoff valves were leaking, and hot wax was getting into the presses during the chilling cycle. Yet the valves were comparatively new.

There's been no such trouble since Crane No. 47X, 150-Pound Gates were installed more than 2 years ago. Their Crane Exelloy trim, suited for temperatures up to 1000 deg. F. keeps giving a tight shutoff on the hot wax, month after month, with easy operation. And they've done so with but routine attention, ever since installed. Better quality is always the bigger value, as every thrifty valve buyer knows.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVE SERVICE RATINGS

SUITABILITY:

Best for the job

FEATURES:

Outstanding Exelloy trim

MAINTENANCE COST:

Routine care only

SERVICE LIFE:

*Good as new—
after more than 2 yrs.*

OPERATING RESULT:

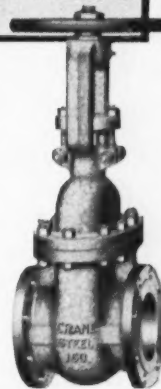
*No production lost
to valve trouble*

AVAILABILITY:

Regular Catalog item—No. 47X

THE VALVE

Workhorse of the petroleum industry—Crane 150-Pound Steel Gates—with exceptional performance assured by Crane quality design—Crane pioneering in steel casting—and the high adaptability of Crane Exelloy trim for most petroleum services. Sizes 2 to 24 in.; screwed, flanged, welding ends. See your Crane Catalog or your Crane Representative.



VALVES • FITTINGS • PIPE • PLUMBING • HEATING

WIDE AVAILABILITY

of

Flash Drying

**DRYING AND
PULVERIZING**

**DRYING WITH
DISINTEGRATION**

**DRYING WITHOUT
DISINTEGRATION**

**COOLING AND
CONVEYING**

IN the chemical and food manufacturing industries, there is wide application for the Raymond Flash Drying System, where products have to be reduced to powdered form and simultaneously dried to a definite moisture content.

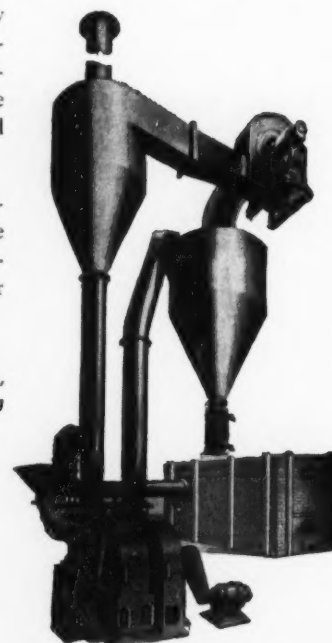
This operation is flexible enough to handle many different types of material in which drying is combined with pulverizing, or with mild disintegration, or followed by cooling and conveying the product to storage. Two stage systems are designed for extremely temperature sensitive materials.

Flash Drying offers increased economies and improved products in processing filter-cakes, hydrate compounds, industrial wastes, various clays, chemicals, pigments, powdered foods, and many other materials.

If you have a special drying-grinding problem, let Raymond engineers advise you in selecting the proper equipment.



CAGE MILL
for Drying
with Disintegration



IMP MILL for
Drying and Grinding

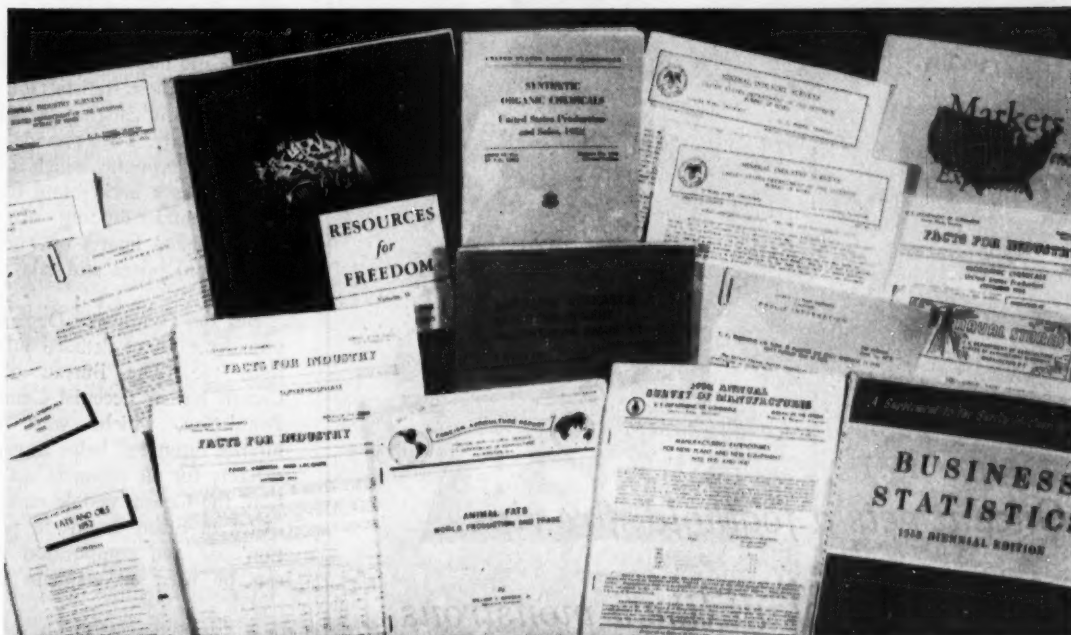
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Chicago 22, Ill.

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Principal Cities



YOU'RE PAYING PLENTY for these and lots of other government publications. Are you using them to full advantage?

Government Statistics Can Help You

Here's a quick guide on where to go within our government to get reliable statistics on everything from fats to fertilizers, incomes to inventories.

No one has yet improved on Disraeli's famous remark: "There are three kinds of lies: lies, damned lies and statistics." Statistics win the palm as leaders among all prevarications because they can be used to give false impressions without actually being based on false data.

Nevertheless, statistics continue to multiply in quantity and improve (despite Disraeli) in quality. And with good reason. Human affairs have become so massive and complex that many of them have to be reduced to numbers before they can be understood. Hence, more statistics, from Dr. Kinsey to the revised Federal Reserve Board Index of Industrial Production.

► **Predict Markets**—The chemical industry is a good example of one that needs statistics. The potential

market for a single new product can extend over several continents and a large variety of possible uses. Studying this market involves knowing the prices and price history of all competing products, the size and growth rate of the industries that might use it and general economic trends in countries that might buy it.

To answer these questions, there are statistics and forecasts available from a huge variety of sources. And the largest single source is the U. S. government.

Most of the major Federal departments collect and publish statistics, as do a large number of smaller agencies within the departments or independent of them. In addition, many of these agencies are ready and willing to take on special studies of rather large mag-

nitude. To help you in your search for reliable market data, here's a rundown of some of the most important governmental sources of statistical information useful to the chemical process industries.

► **Goods, Services, People**—The Commerce Department produces vast quantities of statistical material through the Office of Business Economics and the Bureau of the Census. In addition, the newly-organized Business and Defense Services Administration, although it does not provide statistics, will be instrumental in lightening the load of government requests for data from industry.

BDSA plans to make a thorough study of just what are the best ways for collecting and disseminating statistics. In this way it hopes to insure prompt availability of information for current and future planning by business.

The Office of Business Economics estimates the Gross National Product—the value of all



*Once it gets a foothold, fire rips
into your plant like a monstrous
claw. That means you must guard
every hazard—flammable liquids,
electrical equipment as well as
ordinary combustibles—with
Kidde Portable Extinguishers or
Built-in Systems.
Call your Kidde agent today.*

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Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

ECONOMICS . . .

goods and services produced in the economy. OBE also provides statistical series on construction, private investment, business inventories and sales, personal income, consumer income after taxes and exports and imports—among others.

Many of these statistics are especially useful in gauging overall economic activity. They provide a picture of the economy which is often necessary as a background for any sensible understanding of what more detailed figures on chemical production, prices and sales, really mean.

But the Commerce Department provides a lot of detailed information, too. The Bureau of the Census has its decennial Census of Population, which, with many interim estimates, helps in gauging markets for all products. In addition, the Census people make estimates of future trends in population size and composition which can be used to estimate future

—EAVESDROPPING—



Clark Kerr*

"... there is a very real possibility that we have entered an age of permanent inflation."

"At the end of World War II, competent economists and business men worried over techniques whereby the inevitable recession in business activity could be contained before it turned into a depression. But, contrary to all predictions, the economy of the United States has not experienced an internal readjustment to lower production; the buyers' market for labor has not returned; and prices have not fallen to prewar levels. We are confronted with ample evidence that attention may have been focused on the wrong problem. Instead of recurring depressions we may have to cope with an economic tendency perhaps no less serious than the danger of depression and less amenable to manipulation: there is a very real possibility that we have entered an age of permanent inflation."

*Chancellor of the University of California's Berkeley campus.

markets. Regular and special Census studies deal with changes in the labor force and employment and unemployment, as well as changes in size, location, income and other characteristics of the population.

► **Who Makes What**—The Census Bureau also conducts a Census of Manufactures which contains much detailed information on the size and location of industry, its consumption of materials and its production of thousands of products. The last such survey was taken in 1947, the first in 1810—quite a span of American history.

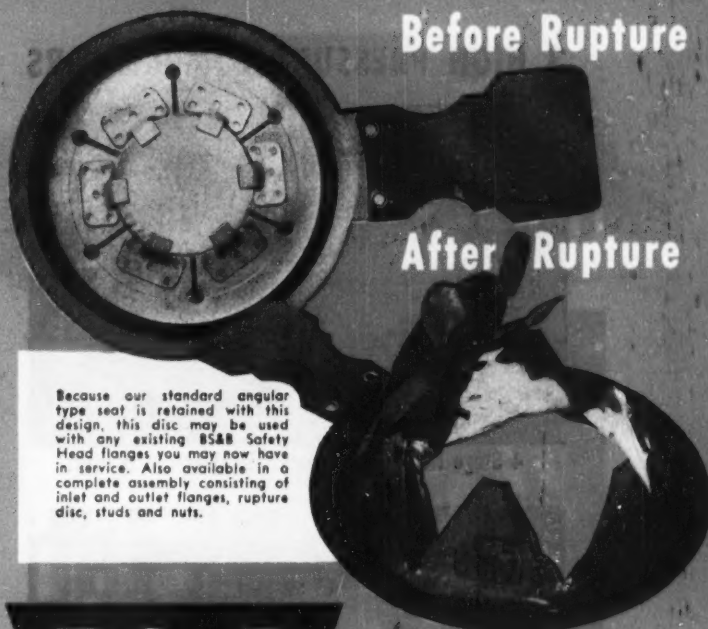
Information for the years between the various Censuses of Manufactures is provided by smaller-scale annual Surveys of Manufactures. These include, among other things, value of manufacturers' inventories, manufacturers' expenditures for new plants and equipment, value of shipments for many selected classes of products and breakdowns of employment and production by geographic areas.

Another of the Bureau's important functions is to compile the "Facts for Industry" series—regular surveys of production and shipments of various specific products. For chemicals, the coverage is extremely wide, ranging from inorganic chemicals to fats and oils, from paints to fertilizers.

Topping off its stupendous statistical task, the Census Bureau collects and publishes statistics on foreign trade in raw materials and processed chemical products. Figures for several hundred chemical products are available every month.

► **Manpower Studies**—The Department of Labor publishes many general economic statistics, plus some that bear very directly on the chemical industry. The department's Bureau of Labor Statistics provides information on new activity in the homebuilding industry, statistics on nonagricultural employment, on the number of hours worked in various industries and average earnings of workers in those industries, and on productivity in various industries.

BLS is probably best known for its price indexes, especially the "Cost of Living" index which is published monthly. The BLS Commodity Price Index is published



Announces

**A NEW DESIGN OF SAFETY HEAD
RUPTURE DISC FOR LOW PRESSURE
APPLICATIONS MODELS 1A AND 1B**

Here is a new BS&B Safety Head rupture disc especially developed for low pressure applications of a type which, because of extreme corrosive conditions, cannot be handled by our standard pre-bulged type of disc.

As you know, the BS&B Safety Head is a patented pressure relief device that is designed to become an integral part of any pressured system containing air, gas or liquid—either bland or corrosive. Disc Models 1A and 1B are constructed of corrosion resistant metals such as Inconel, stainless steel, nickel, Hastelloy B and Monel, using a sealing membrane of Teflon or Kel-F. Either model is available in 2", 3", 4", 6", 8"

and 10" sizes. Pressure ratings range from 8 to 100 lbs. Close design tolerances are an inherent feature of this type of disc.

Our knowledge attained by years of experience in the rupture disc field, combined with continuing research, development and a wide selection of controlled ductile metals has again enabled BS&B to provide industry with a time-proven product.

If you have a pressure relief problem which you have not been able to solve satisfactorily with the pre-bulged type of disc or other types of relief devices, we suggest that you investigate the BS&B Model 1A or 1B disc.

Your BS&B Man will be glad to give you details...or you may write for descriptive literature and prices.

BS&B
Safety Heads

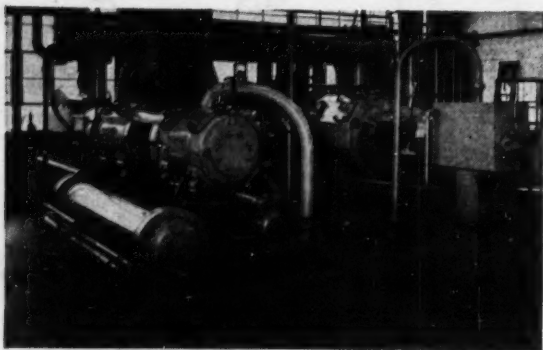


**THE "CIRCUIT BREAKER" OF
Any Pressured System**

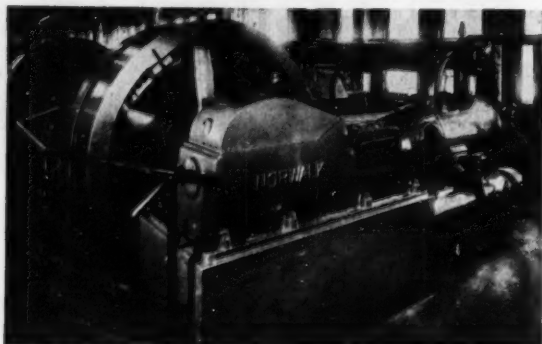
BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2-N2
7500 East 12th St., Kansas City 26, Mo.



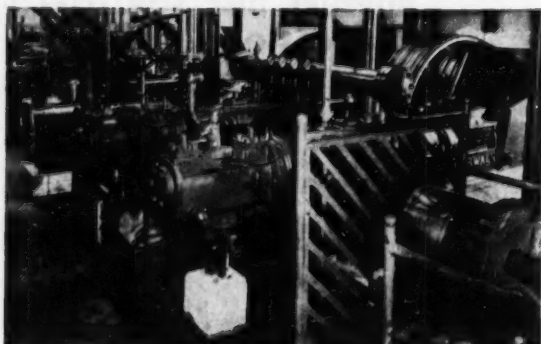
3 HIGH PRESSURE COMPRESSORS



4 Stage Norwalk Compressor in Liquification Plant



4 Stage Norwalk Compressor in Steel Plant



4 Stage Duplex Norwalk Compressor in Dry Ice Plant

Norwalk compressors are built to individual specifications, range from single stage to five and six stages with pressures up to 25,000 pounds. Each compressor is test-run for eight hours at the factory to assure efficient, trouble-free operation. Descriptive catalog forwarded promptly on request.



NORWALK COMPANY, INC.

SOUTH NORWALK, CONNECTICUT

90 years of high pressure experience 1864-1954

ECONOMICS . . .

weekly, monthly and on an annual basis. Included in the overall index are separate price indexes for chemicals, drugs and pharmaceuticals, fertilizer materials, mixed fertilizers and fats and oils.

► **Industrial Production**—The Federal Reserve Board—a partly-government, partly-private organization—produces the standard index of industrial production. This is broken down into a number of sub-indexes, including various groups of chemical products and a number of products that are heavy users of chemicals. FRB also publishes a large number of financial statistics and statistics on department store sales and inventories.

► **Raw Materials**—Rating high among available statistics are the Department of the Interior's Mineral Industry Surveys. The mineral industries supply essential raw materials (and many materials of construction) for the chemical process industries. At the same time, chemistry is vital in the conversion of mineral raw materials into useful products and chemical engineering is becoming increasingly important in mineral production.

The Surveys cover several broad fields, including chemicals, minerals and petroleum. On the chemical side, such products as zinc oxide, coke and coal chemicals, copper sulfate and carbon black are covered from production figures to total sales. Among the minerals surveyed are titanium, sulfur, zinc, cobalt and phosphate rock.

For the petroleum industry, the Surveys provide figures on crude and refined oil production, supply and demand, both domestic and world-wide. In addition, forecasts of supply and demand are made monthly and annually to assist in the formulation of future plans.

► **Money, Money, Money**—The Treasury Department provides statistics on the financial state of the nation and its government. In addition, the Treasury has a direct financial interest in the production of alcoholic beverages and publishes figures covering all that the moonshiners don't manage to hide from official eyes. (There are figures on what the Federal agents uncover, too.)

And the Tariff Commission pub-

lishes production and sales data on plastics and other synthetic organic chemicals. This very important annual study also includes an alphabetical list of individual products by groups and by names of manufacturers.

Also important are the Securities and Exchange Commission and the Federal Trade Commission. These groups publish quarterly figures on profits, sales, assets, plants and equipment and operating ratios for major industries.

The United Nations—not purely an American organization, to be sure—publishes a large body of statistics on income and production in other nations. Much of this material would be extremely useful in estimating potential sales abroad.

All of the above is only a partial listing of the vast amount of material in government publications and files. And it doesn't do justice at all to the many private organizations that provide some of the best statistical material available.

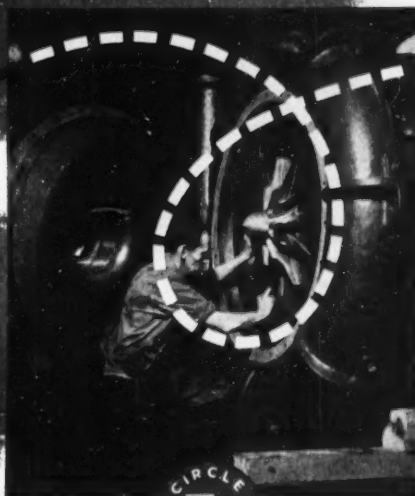
Some of the most useful is collected by periodical publications (for instance, *Chemical Engineering*), trade associations, banks, investment houses and other private organizations. Many of the figures which finally appear in government publications have their origin in these private sources.

For a good, brief listing of some of these sources, as well as government sources, see "What's The Answer," a short booklet put out by the U. S. Chamber of Commerce this year. A Federal Reserve Bank, if there's one nearby, can also point out statistical sources.

And two words of advice. Statistics are only a higher form of lying, as Disraeli implied, when they're misused. They can be misused either accidentally or deliberately. The way to avoid the former is to read carefully the description of any set of statistics before using—make sure just what the figures stand for. That's the first word.

The second relates to deliberate misuse. Of course, no reader of *Chemical Engineering* would be interested in this subject, except that he might be a victim of misuse by others. For the latest word on how figures are deliberately misused, see "How To Lie With Sta-

IN THE CENTER OF A Miniature tornado



LEBANON STEEL  **Castings**
are at work

WHIPPING up a wind as high as 120 mph is the job of Elliott Company's Single-Stage Centrifugal Blowers. In these blowers the "tornado-builder" is a one-piece, open type, radial-bladed impeller—a Lebanon **CIRCLE L** casting engineered to withstand unusual service conditions.

These Elliott Blowers are widely used by the Chemical (particularly in sulphuric acid plants), Power, Refining and Gas industries where they run continuously, 24 hours a day. Such difficult service requires excellence of product design and manufacture, for a stopped blower can mean a plant shut-down. That Lebanon **CIRCLE L** castings are specified by Elliott is recognition, we believe, of the superior workmanship that is traditional with Lebanon Steel Foundry craftsmen.

See—**STEEL WITH A THOUSAND QUALITIES**—37-min., 16 mm, full-color, sound film on the making of steel castings. For information write: Dept. F, Lebanon Steel Foundry.

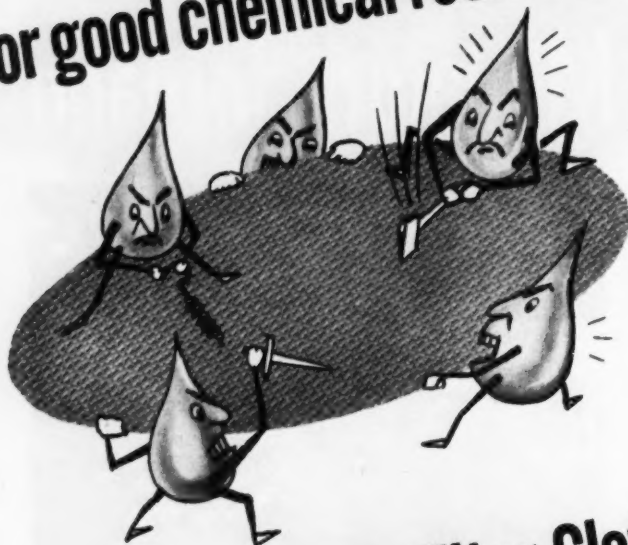
LEBANON  **Castings**

**CARBON, SPECIAL ALLOY
AND STAINLESS STEEL**

LEBANON STEEL FOUNDRY

SHAWNEE, OKLA.

For good chemical resistance—



Use NFM NYLON Filter Cloth

**NFM Nylon Filter Cloth
is not affected by**

Most common alkalis
Most organic acids
Halogenated hydrocarbons
Aldehydes
Ketones
Alcohols
Carbon Bisulphide
Carbon Tetrachloride
Trichloroethylene
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In addition, the fiber strength of Nylon ranks first among all others, whether natural or synthetic. It has excellent heat resistance. It is unaffected by mold, fungi and bacteria growths. The extremely smooth surface of Nylon makes for easy cake discharge—even extremely sticky and tenacious cakes separate freely and cleanly from the face of the cloth. This is important since it reduces blinding and increases flow rates and filter capacity.

NFM Nylon Filter Cloth is available in many weaves, in many widths, in roll lengths or less; or as prepared filter elements sewed with Nylon thread.

Write us for test samples—when you do, tell us about your filter problems.



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ECONOMICS . . .

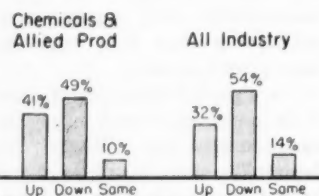
tistics," by Darrell Huff, published by W. W. Norton—an educational, if somewhat disillusioning, book.

Industry Expects to Up Exports This Year

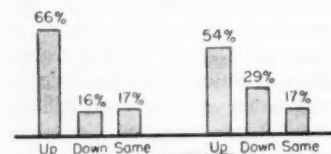
The outlook for exports is showing a rapid, strong improvement, according to a recent McGraw-Hill survey. Not only did business show good gains during the last half of 1953, but a majority of traders look forward to even bigger gains this year.

Competition is stiffening, the replies show, but there also appears to be an overwhelming intention to step up sales effort vigorously in 1954. And despite the reverses of the recent past—now well on the way to solution as world trade forges its way back toward equilibrium and dollar shortages disappear—72 percent of those answering the survey reported that they are more interested than ever in the export market.

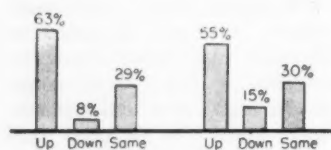
Here's an analysis of the replies from manufacturers of chemicals and allied products, as compared to the all-industry results.



1 How did your export business in the first six months of 1953 compare with that of 1952?

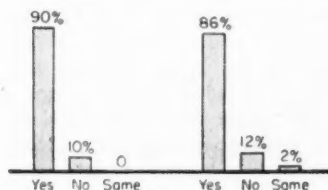


2 What is the outlook for your export business in the second half of 1953?

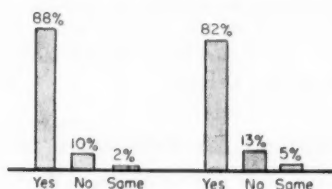


3 What is the outlook for your export business in 1954?

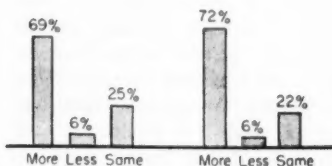
4 What areas do you see as your best markets for 1954?—Here greatest mention was made of Latin America, with the exceptions of Brazil and Argentina.



5 Is there evidence of increasing competition from Europe or local manufacture?



6 Do you anticipate stepping up your sales effort in the export field?



7 Is your company MORE or LESS interested in export in view of changing domestic and foreign conditions?

Bidding Begins for Synthetic Rubber Plants

Anybody who wants to buy a synthetic rubber plant, here's your chance. The government is now accepting bids for parts of its \$500 million industry and has set a May 27 deadline. One congressman, Paul W. Shafer (R. Mich.) has suggested that \$350 million might be a fair price.

A three-man disposal commission will go into action in May to negotiate with bidders. They have seven months after that to put together a disposal package and submit it to Congress which holds veto power over all sales. According to law, the commission must get "full fair value" for the plant, must assure small rubber consumers of a fair share of production and must promote a competitive synthetic rubber industry.

The most important plants to

automatic HIGH PRODUCTION CENTRIFUGALS

A continuous recycling automatic centrifugal unrivaled by any other machine of its type on the market today!

That's the new Roberts G-8 Automatic Electric Drive Centrifugal. It combines fully automatic operation with extra high production features. Many of these production features are exclusive "firsts" for the entire industry.

COMPLETELY AUTOMATIC—All components of the duty cycle are interlocked, assuring accurate timing of successive operations.

ADJUSTABLE, TIMED DUTY CYCLE—Each component of the cycle can be timed to suit your production requirements.

MACHINE OPERATOR—Acts as an observer only; is free to operate one machine or a complete battery.

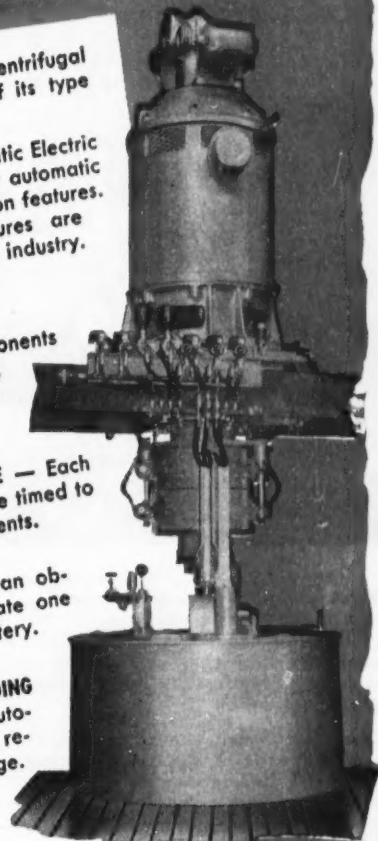
ADJUSTABLE AUTOMATIC LOADING—Loading gate closes automatically when basket has received predetermined charge.

RECYCLING—Automatic recycling assures constant production.

LARGE BASKET—48" x 30" basket enables the G-8 to handle larger loads.

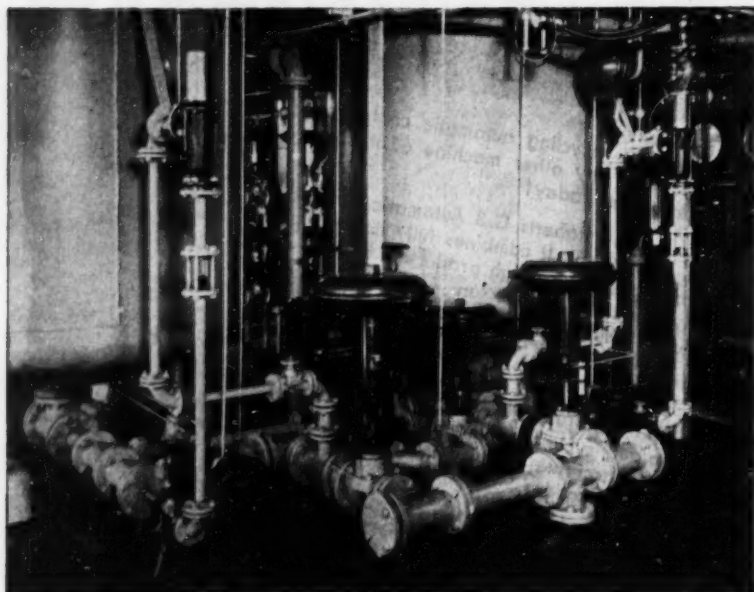
These are just a few of the reasons why the new Roberts G-8 Automatic Electric Drive Centrifugal is the machine for your operations. For further FREE information on the G-8 and other types of Roberts Centrifugals, write to The Western States Machine Company, Hamilton, Ohio.

ROBERTS STEVENS
The
WESTERN STATES
MACHINE COMPANY
HAMILTON, OHIO, U. S. A.



CORROSIVE LIQUIDS CAN'T HURT THIS INSTALLATION

Large midwest corn processor installs SARAN lined pipe, fittings and valves



When one of the largest processors of corn in the midwest was faced with the problem of handling corrosive liquid safely and efficiently in an ion exchange system, they investigated saran lined pipe and fittings.

They learned that saran lined pipe fittings and valves assure tight, leakproof joints. They were convinced that the excellent corrosion resistance of strong, rigid saran lined pipe would mean longer service and greater dependability. The sum total of advantages offered by

saran lined pipe indicated that it would meet the company's demands for equipment that would assure uninterrupted processing free from the expense and inconvenience of unscheduled "shut-downs." Wherever piping with unusual resistance to most chemicals and solvents is involved, install saran lined steel pipe. It can be easily cut and threaded in the field without need for special tools or handling; costly downtime can be reduced to a minimum. We'll be glad to assist you with installation plans. Write or call the Saran Lined Pipe Company, Ferndale, Michigan. Offices in New York • Boston • Pittsburgh • Tulsa • Philadelphia • Chicago • Portland • Indianapolis • San Francisco • Houston • Salt Lake City • Los Angeles • Seattle • Cleveland • Charleston, S. C. • Toronto • Montreal

RELATED SARAN PRODUCTS

Saran rubber tank lining • Saran rubber molding stock • Saran pipe and fittings • Saran tubing and fittings

Saran Lined Pipe Company 1183A	
2415 Burdette Ave., Ferndale, Mich.	
Please send me your data booklet on saran rubber.	
Name _____	
Title _____	
Company _____	
Address _____	
City _____	State _____

SARAN LINED PIPE COMPANY

2415 BURDETTE AVENUE, FERNDALE, MICHIGAN

ECONOMICS . . .

be sold are the GR-S producers at Baton Rouge and Lake Charles, La., and at Baytown, Borger, Houston and the two at Port Neches, Tex. The two butyl rubber plants operated by Jersey Standard Oil are also included in the package.

The major groups interested in the bidding are large rubber companies, petroleum companies (because of their supply of butadiene), chemical companies (because of their supply of styrene) and small tire and fabricating companies. An important stipulation is that each bidder must tell how it will get the necessary raw materials, butadiene and styrene.

Demand for Petroleum to Rise 2.9 Percent in 1954

According to latest Bureau of Mines forecasts, the total demand for petroleum products will go up about 2.9 percent this year over 1953. Domestic demand should jump 4.0 percent while total exports are expected to drop about 20 percent. At the same time, domestic crude oil production will reach 6,556,000 barrels daily—up 1.1 percent—and total imports are estimated at 1,096,000 bpd., a gain of 5.0 percent.

EAVESDROPPING



H. S. M. Burns*

"... there is a very real possibility that we have entered an age of permanent inflation."

"There is scarcely a day passes that we do not hear the loose statement made that the oil business is just one big monopoly. The fact that so many brands of petroleum products are available in every community of the United States and that there are so many rival claims for superiority, all of which must be well-known to you or else you haven't been reading your newspapers, must in itself make any talk of monopoly in the oil business stand out as the fairy tale which it is."

* President, Shell Oil Co. at the 33rd annual meeting of the American Petroleum Institute.

Preliminary estimates indicate that domestic crude oil production averaged about 6,487,000 bpd. in 1953, an increase of 6.0 percent over 1952. Total demand for refined products hit 8,340,000 bpd.—up 5.1 percent.

A detailed summary of the estimates and forecasts is shown below. It should be noted that abnormally mild weather substantially reduced the demand for heating oil last year. The large increase in distillate fuel demand expected in 1954 is based on the assumption of more normal (i.e., cooler) weather during the year.

1953 Petroleum Market Estimate

	Barrels per Day (Thousands)	Change over 1952 (Percent)
Production		
Crude Oil.....	6,487	+ 3.6
Other light oils.....	666	+ 9.9
Imports		
Crude oil.....	653	+13.8
Products.....	391	+ 1.8
Total.....	1,044	+ 9.1
Demand		
Domestic—Total.....	7,721	+ 6.0
Gasoline.....		+ 7.1
Residual fuel.....		+ 3.6
Distillate fuel.....		+ 5.7
Kerosine.....		+ 1.5
Other products.....		+ 8.4
Exports—Total.....	386	-11.0
Crude oil.....		-29.0
Products.....		- 8.0
Total.....	8,107	+ 5.1

1954 Petroleum Market Forecast

	Barrels per Day (Thousands)	Change over 1953 (Percent)
Production		
Crude Oil.....	6,556	+ 1.1
Other light oils.....	710	+ 6.6
Imports.....	1,096	+ 5.0
Demand		
Domestic—Total.....	8,030	+ 4.0
Gasoline.....		+ 5.0
Residual fuel.....		- 2.0
Distillate fuel.....		+ 9.0
Kerosine.....		+ 4.0
Other products.....		+ 3.0
Exports—Total.....	310	-20.0
Crude oil.....		-36.0
Products.....		-17.0
Total.....	8,340	+ 2.9

Sales of Auto Polishes Triple in Four Years

The use of silicone auto polishes has enabled finish and polish manufacturers to triple their sales to America's car owners since 1949. And there's still a big potential market.

According to T. H. Reilly, sales development supervisor for GE's Silicone Products Dept.,* at least 35 percent of this country's automobile owners don't polish their cars at all. New, easily-applied silicone polishes should soon make major inroads on this huge, untapped market.

Reilly, while emphasizing that

* In an address before the Chemical Specialties Manufacturers Association.

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natural iron oxide
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very very fine

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VVF pigments are produced by our unique grinding process to give a very, very, fine product controlled for top particle size and particle size distribution.

VVF pigments will reduce your grinding and dispersing time in paints and allied products as much as 75%.

VVF pigments give you brighter mass color, stronger tint, increased hiding power, and higher gloss than standard grind pigments.

VVF pigments now available are—Raw and Burnt Siennas, Raw and Burnt Umbers, Metallic Browns, Red Iron Oxide, and Primer Pigments.

Your Williams representatives will gladly give you complete information on this new pigment group—or mail coupon for illustrated VVF TECH REPORT.

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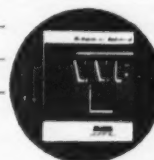
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ECONOMICS . . .

inclusion of silicones in a product does not imply unquestionably high merit, also predicts that in the future it will be easier to re-paint cars if they are covered with silicone polish. Introduction of new clean-up procedures before refinishing permits newly-applied paints to be smoother, stronger and to have better adhesion.

Chemical Industry Gets Hot About Tariffs

By and large, the chemical industry is getting pretty steamed up about possible wholesale tariff cuts. The feeling through the industry that the Randall Commission on Foreign Economic Policy has definite "low-tariff leanings" has recently brought out a number of strong rebuttals to the theory that "trade, not aid" should be the nation's policy.

Even though it hasn't yet been badly hurt by foreign competition, the chemical industry seems intent on nipping in the bud any threat of a flood of cheap chemical imports.

The first big move was made by Monsanto when the company submitted its resignation from the National Assn. of Manufacturers because of alleged NAM tendency to advocate lower tariffs. It followed this up with a letter of resignation to the U. S. Council of the International Chamber of Commerce for the same reason.

Next in the parade was the Manufacturing Chemists' Assn. with a strongly-worded statement to the Randall Commission. Maintaining that what we need is trade plus protection, the statement said that because of the high essentiality of chemicals to all manufacturing, agriculture and defense, tariff rates applicable to chemicals should be examined with great care and should be established by individual products or product groups rather than on an across-the-board basis.

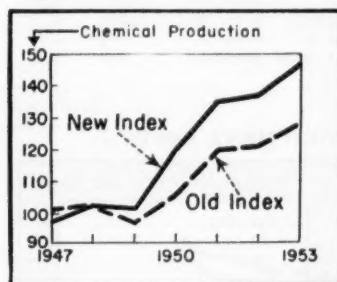
MCA also pointed out that duties on chemicals have been reduced 38 percent since 1945, mostly in 1951. Therefore, it is clear, the statement points out, "that the U. S. chemical industry has not yet felt the full force of competition under present tariff

rates from foreign chemical industries which are still being revitalized and expanded."

An even stronger stand was taken by the Synthetic Organic Chemical Manufacturers Assn. which told the Randall Commission, in a 231-page statement, that lowering tariffs in the organic chemical industry would not only undermine national security and affect the vigor of our entire domestic economy, but would also be a "cruel deception" on those who seek to stimulate world trade.

SOCMA also offered some concrete suggestions on how to attain the administration's foreign economic policy goals. Among them were encouragement of private investment abroad by Americans; more liberal use of Trade Agreement Act authority to equalize trade opportunities with countries that restrict imports from the U. S.; possible increase in the Export-Import Bank's capitalization and lending powers.

HIGHLIGHT OF THE MONTH

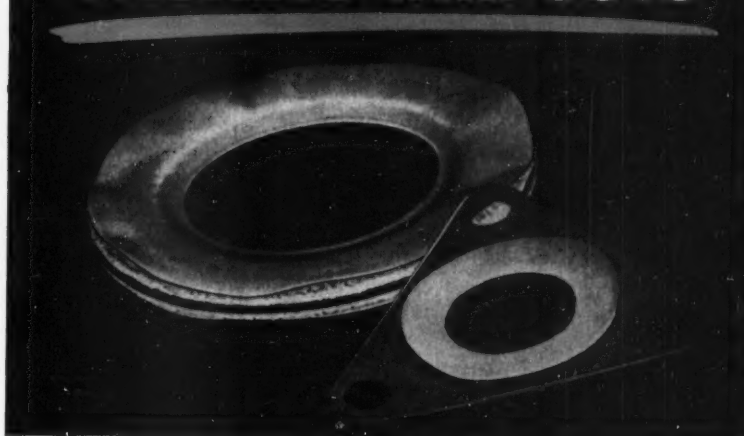


The Federal Reserve Board has just revised its index of total industrial production in the U. S. and chemicals are being given more weight. The chemicals output index is also related to a new base period, the average of three years 1947-1949. The old base was the five-year average, 1935-1939.

Chemicals are represented in more detail by the new index. There are now 12 physical quantity series for inorganic chemicals. And physical production series replace man-hour data for synthetic resins, cellulose plastics, synthetic rubber and man-made fibers.

The new chemicals output index rose almost twice as fast on the new basis as on the old. Between 1947 and 1953, the increase in output was 52 percent in the new index, only 28 percent on the old.

GASKETS with GUTS



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Gaskets

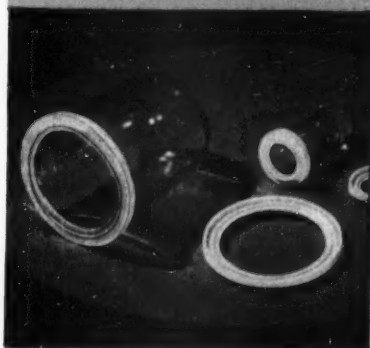
Laugh at Acids, Caustics, Solvents

Chemiseal Gaskets have become standard for corrosion and contamination problems because—made of TEFLON—they are inert to all chemicals excepting molten sodium and fluorine.

Chemiseal Teflon-Jacketed Gaskets are available in any size, with a variety of filler materials suitable for glass, glass-lined, porcelain, Karbate, Havg, stainless or other metal piping and equipment.

These fillers are protected on both faces and the inside diameter by the chemical resistant Teflon Jacket.


Ask for Catalog No. 1-339 WA.



Chemiseal Snap-On Gaskets, molded from Solid Teflon are available with projections matching grooves in pipe ends of all conical and glass pipe joints. Ask for Catalog No. 820.

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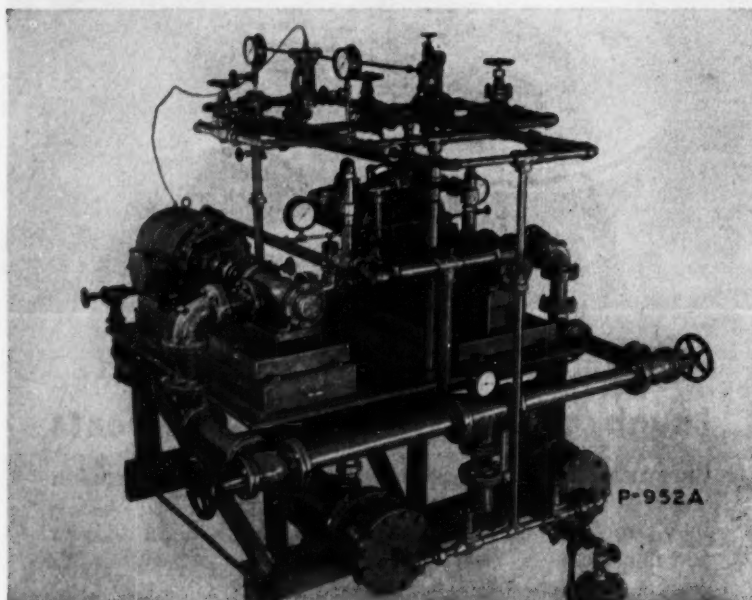
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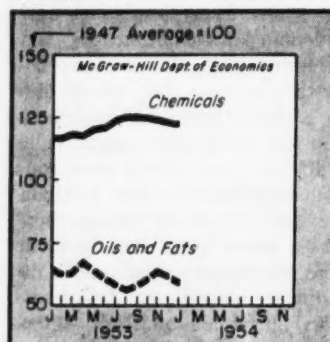
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THIS MONTH'S

Industry

PRICES...

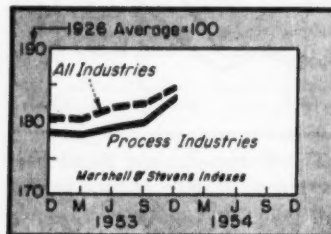


CHEMICAL ENGINEERING'S PRICE INDEXES

CHEMICALS.....	123.9	-0.5%
OILS & FATS.....	61.4	-2.8%

		Chemicals	Oils & Fats
As of	January 1, 1954	123.91	61.36
Last Month	December 1953	124.48	63.13
Year ago	January 1953	117.92	65.22
Two years ago	January 1952	121.62	68.28

EQUIPMENT COSTS...



ALL INDUSTRIES.....	184.8	+1.2%
PROCESS INDUSTRIES.....	183.5	+1.8%

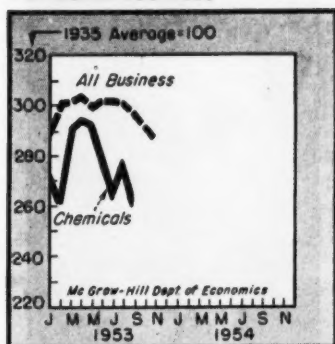
Industry	Dec. 1952	Sept. 1953	Dec. 1953
Average of all	180.8	182.6	184.8
Process Industries			
Cement mfg.	173.0	174.3	177.8
Chemical	181.4	182.7	186.4
Clay products	168.0	169.2	172.6
Glass mfg.	171.4	172.7	176.2
Paint mfg.	174.7	176.0	179.5
Paper mfg.	175.0	176.3	179.8
Petroleum ind.	178.1	179.4	183.0
Rubber ind.	180.5	181.8	185.4
Process ind. avg.	178.9	180.2	183.5
Related Industries			
Elec. power equip.	183.3	184.6	188.3
Mining, milling	182.4	183.7	187.4
Refrigerating	201.2	203.1	204.9
Steam power	171.0	172.3	175.7

Compiled quarterly by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. For a description of the method of obtaining the index numbers see R. W. Stevens, Chemical Engineering, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see Chemical Engineering, March 1953, pp. 220, 221.

Trends

Douglas Greenwald

CONSUMPTION...



INDEX FOR ALL BUSINESS

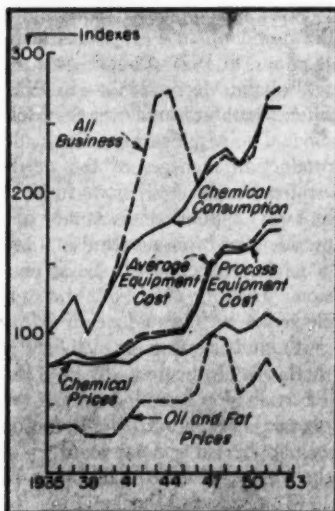
	Nov.	Oct.	Sept.
INDEX	287.9	291.6	296.1

INDUSTRIAL CHEMICALS INDEX

	Nov. (Est.)	Oct. (Prelim.)	Sept. (Revised)
INDEX	268.0	274.9	266.5

Fertilizer	56.11	53.56
Pulp & Paper	31.33	33.05
Petroleum Refining	27.36	27.70
Iron & Steel	15.98	17.33
Rayon	23.88	26.55
Glass		23.10
Paint & Varnish		28.86
Textiles		10.76
Coal Products		12.01
Leather		3.98
Explosives		10.25
Rubber	5.47	5.96
Plastics		19.20

LONG TERM...



CHEMICAL ENGINEERING—February 1954

does this indicate
correct pH
or reduced input voltage?

Many experiments — colorimetric analysis, gas analysis, and others — are complicated unnecessarily by poor voltage. Under erratic line voltage conditions, reliable instruments may give readings that indicate voltage changes rather than measurements of substances being tested.

The chemist whose work is hampered by unsteady line voltage will do well to purchase a Sorensen electronic AC regulator, such as the model 150S illustrated herewith. This regulator controls voltage to $\pm 0.1\%$ with good waveform. Waveform is extremely important, since most laboratory instruments require a clean 60-cycle sine wave input in order to function properly.

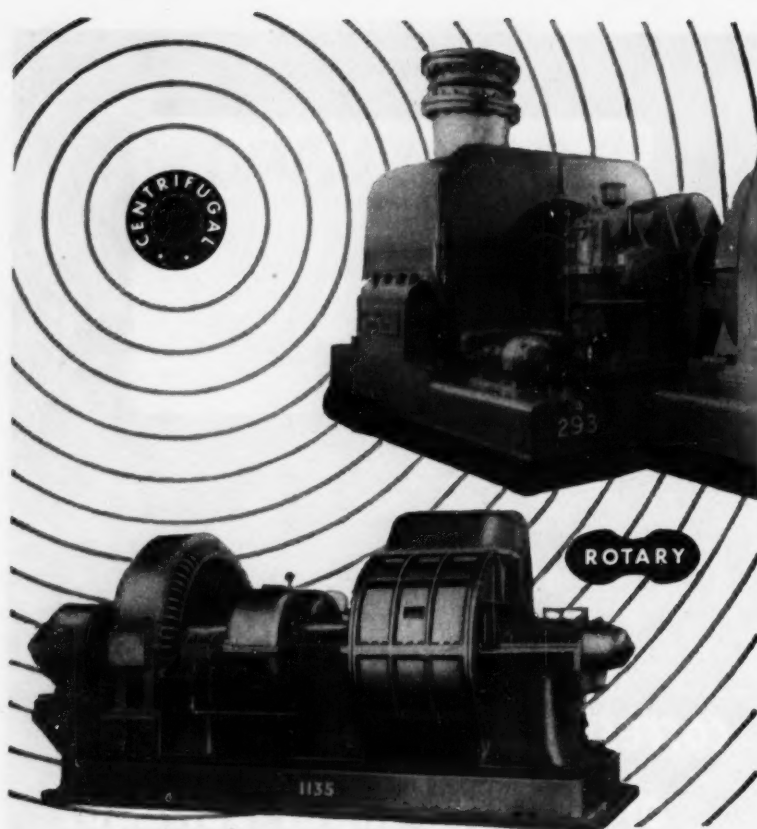
In addition to giving close regulation with good waveform, the Sorensen regulator is dependable, trouble-free, reasonably priced. Instruments are available in a wide range of capacities to meet widely divergent needs; there are also extremely precise regulators accurate to $\pm 0.01\%$.



Sorensen instruments employing similar circuitry are widely used in science and industry to supply regulated DC in high and low voltages, very heavy current for plating and electrolytic processes, and with very precise regulation for powering spectrophotometers. Write for full information to Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn.

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THIS MONTH'S

Names in



Osborne Bezanson

A veteran of 48 years of continuous service with Monsanto and its affiliated companies, Mr. Bezanson is now chairman of the board of directors of The Chemstrand Corp., a jointly owned associate company of American Viscose Corp. and Monsanto Chemical Co. Henry H. Bitler takes over the presidency which Mr. Bezanson has held since 1950.

Following his graduation from high school, Mr. Bezanson went to work in 1906 as a laboratory assistant for the Merrimac Chemical Co. After four years in the laboratory and intensive outside study, he was made chief chemist and later entered the operating and production phases of the company. In 1920 he was appointed assistant to the president, in 1921 works manager, and in 1927 production manager of the Merrimac Co. In 1929 when Monsanto took over the Merrimac Co., Mr. Bezanson was made production manager of the newly created Merrimac division. In 1935 he was appointed assistant vice president of Monsanto and in 1942 general manager of the Texas division. In the same year he was elected a vice president of Monsanto and became a member of the board of directors. In 1943 the Texas division became a part of the organic division and Mr. Bezanson was appointed general manager of the organic chemicals division. In 1948 came membership in the

the News

H. D. Christopher

company's executive committee followed by the presidency and membership in the board of Chemstrand. He brought to completion the Chemstrand administrative headquarter facilities, multi-unit research and development center and Acrilan acrylic fiber manufacturing plant near Decatur, Ala., and has brought to within start-up range the Chemstrand nylon plant near Pensacola, Fla.

In the past 15 years, Mr. Bezan-son has been responsible for building and operating a \$20,000,000 government TNT plant at Karnack, Tex.; building and operating the vast Texas City installations of Monsanto, and managing the six-plant Organic Division.

M. L. Owens. Group leader in research dept. of Monsanto's Texas division. With company since 1951.

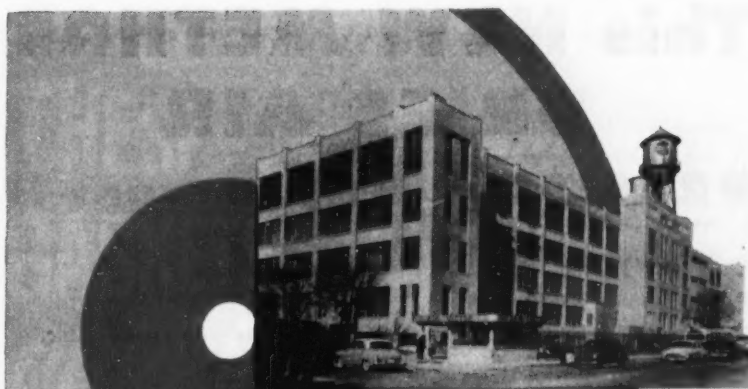
Byron E. James. Elected to board of directors of McQuay Inc. Re-joined company in 1953 as vice president in charge of engineering and research. Previously with York Corp. and Liquid Carbonic.

Henry C. Millerburg. From executive vice president to president, Loven Chemical of California, Inc.

Charles C. Cheyney. Director and sales manager of Buffalo Forge, elected vice president of sales and engineering.

John A. Anthes. Sales project engineer, machinery division, Dravo Corp. Formerly with American Cyanamid and Union Oil Co. of Calif.

John B. Fenn. Consultant, elected to board of directors of Thermal Research & Engineering Corp. Currently technical director of Project Squid. Formerly with Experiment, Inc., Sharples Chemicals and Monsanto.



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... compactly designed: Mixer has enclosed motor connected directly to specially designed high speed mixing rotor. Standard rotor consists of 2 steel discs spaced over 1" apart by exclusively designed impactors. Material is spouted into mixer and is directed by distributor to rotor center, where it is spun out by centrifugal force into thinning film as it approaches rotor perimeter. Uniform discharge through hopper to outlet.

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- ▶ to protect your processing of moisture-sensitive material
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The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is

Best and most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always. Niagara machines using liquid contact means of drying air have given over 20 years of service.

Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Easiest to take care of because . . . the apparatus is simple, parts are accessible, controls are trustworthy.

Most compact, taking less space for installation.

Inexpensive to operate because . . . no re-heat is needed to obtain the relative humidity you wish in normal temperature ranges and frequently no refrigeration is used to remove moisture.

The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.



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This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

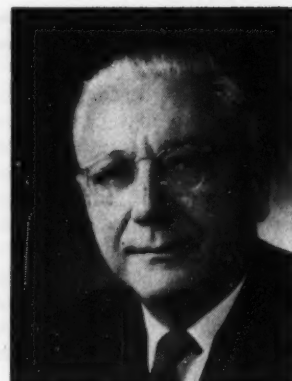
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District Engineers in Principal Cities of United States and Canada

NAMES . . .



Marlin G. Geiger

Vice chairman of the board of directors, Mr. Geiger was elected president and chief executive officer of The Davison Chemical Corp. following the resignation as president of R. L. Hockley.

Mr. Geiger, after long experience as a production and general management leader in the chemical industry, joined Davison as executive vice president in 1947. In the same year he was elected to the board of directors and in 1951 became vice chairman of the board. In that position he had executive responsibility for all company activities in research and development, chemical operations and engineering, including the design, engineering and construction phases of the company's current expansion program. Mr. Geiger has taken a particular interest in the corporation's industrial safety program. The many awards won by Davison for its outstanding safety record bring invitations to Mr. Geiger to speak to regional and national associations on management's safety responsibilities.

A native of Harrisburg, Pa., Mr. Geiger was educated in chemical engineering at Pennsylvania State College. His first employment was as a chemical engineer with Westvaco Chlorine Products Corp. in 1921, and before joining Davison, he was a vice president and director of Westvaco. He is also a former vice president and director of United Chemicals, Inc.; former president and director, W. Va. Charcoal Co.; former president and director, First National Bank of

South Charleston; former director of W. Va. Manufacturers Association, and former resident manager of Magnesol Co.

A firm believer in the benefits to business men of participation in both community industrial and professional group activities, he holds membership in many organizations.

H. A. Hashbarger. Supervisor of new production planning and control section in production dept. of Monsanto's organic chemicals division. With company since 1937, most recently as development manager of company's foreign dept.

Lloyd Drake. Sales manager, chemical color div., Reichhold Chemicals. With company since 1948.

Paul Fugassi. Professor of chemistry at Carnegie Institute of Technology appointed director of Coal Research Laboratory in Carnegie's chemistry dept. With Carnegie since 1935. Previously at U. of Wisconsin.

John M. Hoerner. Chemical division director of purchases and sales, Armour and Co. Previously with Atlantic Refining Co.

Lester B. Swan. From assistant general manager of Dowell Inc. to executive vice president of Brazos Oil and Gas Co., subsidiary of Dow Chemical. With Dowell since 1940. Previously with Stanolind Oil and Gas Co.

Robert Shattuck. From vice president and general manager to president of Marbon Corp., subsidiary of Borg-Warner. With company since 1942. Formerly with U.S. Gypsum.

James Albert Woods. President of Commercial Solvents Corp. elected a director of American Smelting and Refining Co.

John A. Mullendore. Director of special engineering projects at Monsanto's Nitro, W. Va., plant. With company since 1950,

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are far superior to ordinary gaskets for use under severe corrosive conditions. They last many times longer—even when handling stronger acids, halogens, organic solvents and other corrosives at very low, normal and even very high temperatures. They are now used for heat exchangers and columns, condensers, reactors and kettles. Where the application requires thick gaskets, Chempro Teflon Gaskets are less expensive and have better mechanical properties than solid teflon. Chempro Teflon Gaskets are made with an outer jacket of corrosive resistant Teflon and with a resilient and flexible core of compressed asbestos and laminated woven asbestos sheets. Other special core materials can be used depending upon your specific needs.

Chempro designs and manufactures a complete line of packings and gaskets in Teflon and other plastic materials. Look over the series shown below. There's a type to fit your special needs.

Style 10-1—Teflon* Jacket. Center core of compressed asbestos between woven asbestos cloth. ▶

Style 10-2—Same as above but with corrugated Stainless Steel core. For higher operating pressures. ▶

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Style 10-4—Teflon Jacket. Corrugated Stainless Steel insert. For high temperatures and pressures and low bolt loads. ▶

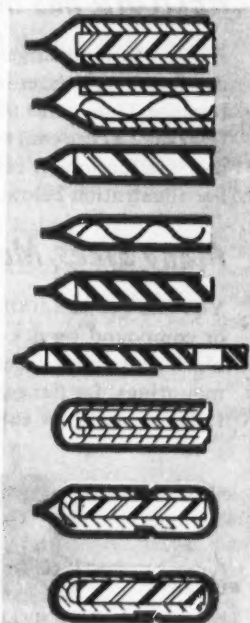
Style 10-5—Teflon Jacket. Neoprene core 1/16" or 1/8" thick. For applications requiring greater deformability. ▶

Style 10-6—Teflon Jacketed Full Face Neoprene Gasket with Bolt Holes. Core may be of any construction or variety of specified material. ▶

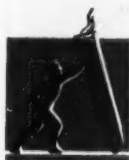
Style 20-1—Method of Teflon Jacketing special sizes, irregular shapes and diameters of 12" and over. ▶

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Style 221-1—Molded Shield Double Teflon Jacket for large diameters and special shapes and sizes. ▶



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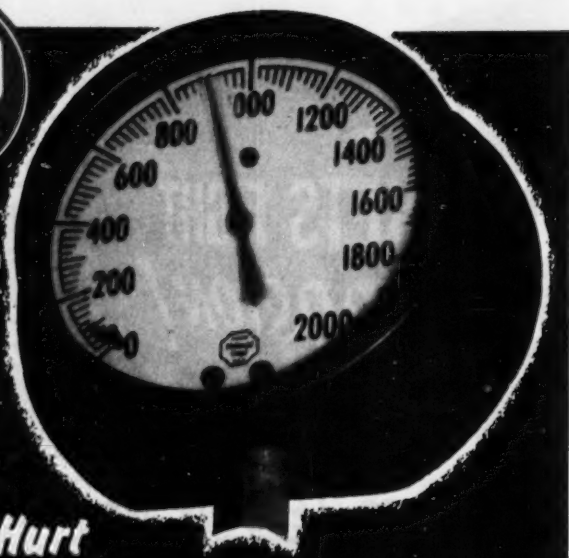


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HELICOID has no gears to wear out!

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NAMES . . .

most recently in the process section of the organic chemicals division.

Robert M. Aude. Manager of Heyden Chemical Corp.'s Fords, N. J., plant. Formerly with Monsanto.

A. H. Andersen. Technical director, Shawinigan Chemicals Ltd. With company since 1926. His successor as director of development: **F. K. Rogers**, with company since 1945, most recently as assistant director of development dept.

George O. Bohrer. Chief engineer, Magnesium Co. of America. Formerly with Continental Can and Boeing Aircraft. New vice president in charge of research and development: **C. Ridgely Kemp.** His successor as vice president in charge of production: **William R. Davison.**

William H. Erwin. International division director in Atlas Powder Co.'s industrial chemicals dept. With company since 1939.

J. Harry DuBois. Vice president, engineering, elected a director, Mycalex Corp. With company since 1952. Formerly with General Electric, Shaw Insulator, and Plax Corp.

Richard J. Both. Sales manager, agricultural chemicals, naval stores dept., Hercules Powder Co. With company since 1940, most recently as assistant sales manager.

John K. Lindsay. Export manager, international division, Wm. S. Merrell Co. With company since 1947.

Albert F. Metz. From president to chairman of the board and chief executive officer, Okonite Co. Other changes: **R. Stuart Keefer**, from vice president in charge of sales to president; **Edward D. Youmans**, from vice president in charge of manufacturing and research to vice presi-

dent in charge of research and product development; **Charles M. Kirkland**, from factory sales manager at Passaic, N. J., plant to vice president in charge of sales; and **David W. Nurse**, from resident manager of Wilkes-Barre, Pa., plant to vice president in charge of manufacturing.

G. Karl Vogelsang, Technical director, Gates Engineering Co., Wilmington, Del. Formerly with Durite plastics unit of Borden's chemicals division.

Carleton Ellis, Jr. Director of sales for all Plaskon products, Barrett division of Allied Chemical & Dye. New general sales manager: **Sam Gurley**, formerly Barrett resin sales manager.

Leon W. Seigle, Manager, intermediate sales, National Aniline Division, Allied Chemical & Dye. With company since 1939.

Chester H. Peterson. From executive vice president to president of U.S. Rubber Reclaiming Co., succeeding **Jean H. Nesbit** who becomes chairman of executive committee.

Duncan J. MacLennan. Sales manager of plasticizer division, Pittsburgh Coke & Chemical Co. Formerly with Whitney Chain Co. and Godfrey L. Cabot Co.

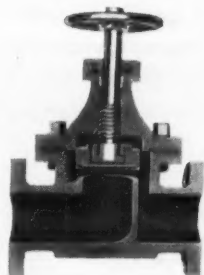
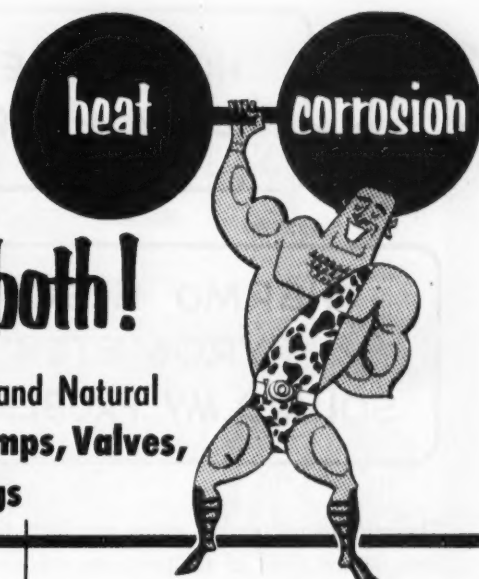
Wright W. Gary. President and chief executive officer, Attapulug Minerals & Chemicals Corp. Formerly with Filtrol Corp. and national director of refining for United States Petroleum Administration.

John A. Matousck. From vice president of manufacturing to vice president and general manager, Baker-Raulang Co. With company since 1949. Formerly with Detroit division of Hupp Corp.

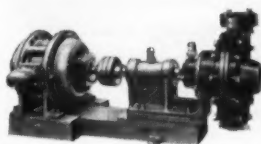
Ellis B. Gardner and **Robert A. Nilssen**. Vice presidents, Hewitt-Robins Inc. Mr. Gardner, with the company since 1946, was

Buna N handles both!

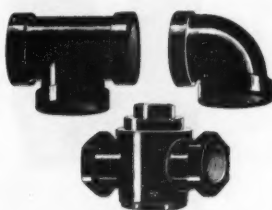
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formerly with General Electric. Mr. Nilsen, general manager of company's foam rubber division, joined the company in 1946 after an association with United States Rubber Co.

Bernard H. Schenk. From vice president to president of Visking, Ltd., Canadian subsidiary of Visking Corp., Chicago. New chairman of the board: **J. Paul Smith**, president of the parent company.

A. L. Foscoe. President of Electro Metallurgical Co. and United States Vanadium Co., divisions of Union Carbide and Carbon Corp., succeeding **Walter E. Remmers**, chairman of both companies and vice president of the parent company. Mr. Foscoe has been with Union Carbide since 1924, most recently as vice president of Electro Metallurgical Co.

Robert F. McClellan. Vice president and general manager, Yocum Faust, Ltd., subsidiary of Nopco Chemical Co. and major Canadian producer of industrial processing chemicals. Formerly mid-west district manager of Nopco. With company over 25 years.

S. Sydney Minault. Chief engineer, equipment division, National Research Corp. Formerly with Tracerlab, Inc., Anasco, and Sperry Gyroscope.

Stuart B. Smith. President of Henry Pratt Co. of Chicago, elected a director of Vitro Manufacturing Co. and Vitro Corp. of America. Associated with Vitro since 1943.

Donald L. Katz. Chairman of the department of chemical and metallurgical engineering at the University of Michigan, appointed a member of the editorial advisory committee for the McGraw-Hill Chemical Engineering Series of texts and reference books. Organized in 1925 under the chairmanship of Dr. H. C. Parmelee, this committee of representative

industrialists and educators first recognized the need and laid the groundwork for a coordinated literature in chemical engineering. The series now comprises approximately thirty texts and handbooks, some of which have already gone through three and four editions and have been translated into foreign languages. S. D. Kirkpatrick has succeeded Dr. Parmelee as chairman and consulting editor for the Chemical Engineering Series.

—EAVESDROPPING—



A. W. Peake*

"Increased competition is not something to be sad about."

It is a strange thing to me how some of the greatest values of competition are often overlooked. It is easy enough for us to see how it works for the customer's benefit. It is easy enough to see how it serves as an accelerator in our business system. Yet, too often, we overlook the very significant fact that should be equally obvious: the fact that competition benefits all of us.

If the forces of competition occasionally prove painful, such aches fall in the category of growing pains. For it is out of competition that growth comes. It forces us to be efficient. It forces us to develop greater product quality and better services. It forces us to new operating methods and devices, new ways of thinking and new ways of doing. It is the reason that the United States has outstripped the world in industrial production and standard of living.

I might add that bucking stiff competition is the best way in the world to learn valuable lessons. Our competitors, certainly, have taught us at Standard some of the marketing facts of life. For these lessons we are duly grateful, although I will confess that our gratitude was restrained when the lessons were first administered.

* President, Standard Oil Company (Indiana). An address before the Marketing Division, American Petroleum Institute, Chicago, Nov. 9, 1953.

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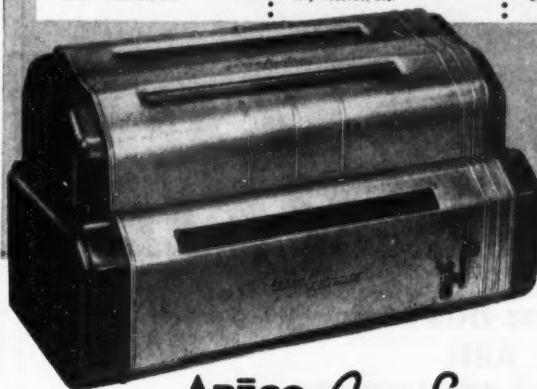
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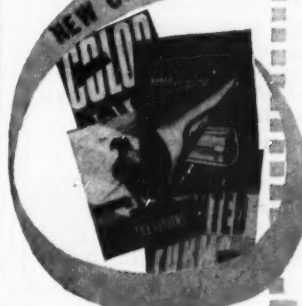
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THIS MONTH'S

Man of



BARNETT F. DODGE

Newly elected vice president of the AIChE is now in Spain "spreading the gospel of chemical engineering."

News of his election as the new vice president of the AIChE came to Yale's Dr. Dodge when, characteristically, he was "on the go." This time he was off to Spain at the behest of the State Department to, as he puts it, "spread the gospel of chemical engineering."

This latest assignment gives Professor Dodge another chance to combine his favorite hobby, travel, with his favorite work, teaching chemical engineering. For two months of his three-month stay he'll be lecturing on chemical engineering fundamentals at the University of Barcelona.

What's more, he'll lecture in Spanish.

You see, languages are another of his hobbies. When he served as Fulbright Lecturer at the University of Toulouse in France, he conducted all of his lectures in French. And if he'd have had more time to prepare for his trip to Japan in the Summer of '51—for a series of meetings with Japanese educators—he'd have probably tried his hand at learning Japanese.

For "Barney" Dodge is a man of uncommon energies and myriad

the Month

H. T. Sharp

interests. A listing on his publications on the various aspects of chemical engineering—headed by his much-referred-to book, "Chemical Engineering Thermodynamics"—would easily fill these columns. An authority on the thermodynamics of fluids at high pressures, he is also an expert on industrial waste disposal.

In addition to heading up Yale's Department of Chemical Engineering, Dr. Dodge currently serves as consultant to several industrial firms and to the AEC's Brookhaven National Laboratories. He spent some time working at Brookhaven last summer and has continued in an advisory capacity.

His interest in atomic energy dates to a World War II association. He worked for the Fercleve Corp. on the Manhattan Project at the Clinton Engineer Works. All experimental investigations and plant control work on the separation of uranium isotopes came under his direction.

During the war he helped develop portable oxygen generators for the Navy. And, in addition, served as an investigator with the National Defense Research Corp.

His election as vice president of the Institute is fitting recognition of his administrative ability, technical competence and his 27 years of energetic participation in AIChE affairs.

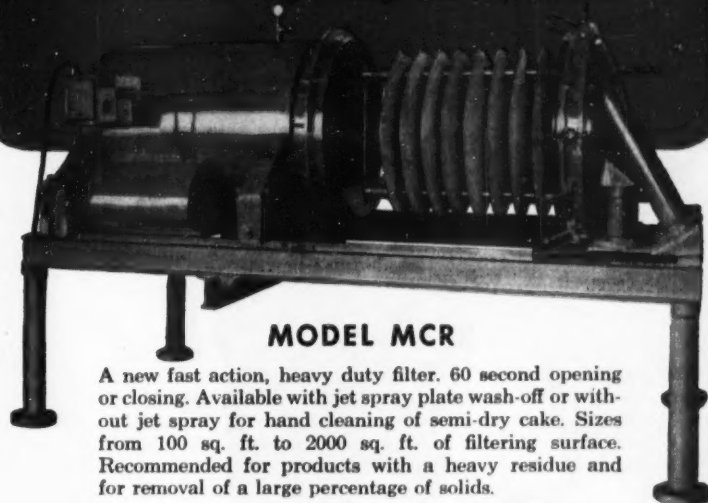


Yale University News Bureau

(Continued)

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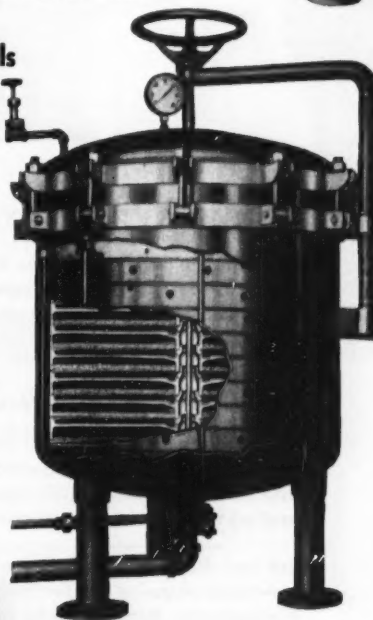
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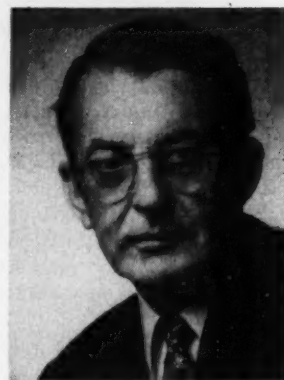
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OBITUARIES



John H. Perry

John Howard Perry, the man whose name is known throughout the length and breadth of our profession, died December 13.

Jack worked hard and long for the profession he loved. In addition to his regular duties in the development department of Du Pont, he somehow managed enough extra projects to keep many men busy. His "Chemical Engineers' Handbook," by chemical engineers, for chemical engineers, is an indispensable tool for all of us—and will long continue to be.

Jack also gave his energies generously to the professional societies. He believed that to belong to an organization is to work for it. He proved this by working many years and serving on most of the major standing committees of the AIChE. Besides these activities, Jack had to his credit a list of technical publications that would more than fill this page. He was also hard at work on "Chemical Business Handbook" which will be published within the next few months.

His professional positions included: The Maine State Experiment Station; The American Agricultural Chemical Co.; the U.S. Ordnance Department at the first (Haber) U.S. synthetic ammonia plant at Sheffield, Ala.; consultant for the Hearst papers; the U.S. Bureau of Mines Helium division; and, since 1925, with E. I. du Pont de Nemours & Co. His more than 25 years with Du Pont have included research and development in sulfuric acid, ammonia, and nitric acid manufactures; high pressure organic syntheses; general

heavy chemical development; and for the past 12 years with the central development department, specializing in technical economics and general business.

This is only a very scant outline of some of the things J. H. Perry has done in his lifetime. It is said that no one really dies whose work endures. And the work of Jack Perry will endure so long as there is a chemical engineer anywhere standing ready to improve on nature and the world we live in.

James H. King, 61, vice president and director of Babcock & Wilcox died Nov. 14 in New Rochelle, N. Y. With company since 1914.

John H. Pressley, 72, retired executive of Sun Oil, died Nov. 14 in Dallas, Tex. With company since 1902.

Harry J. March, 54, vice president, director and general counsel of Signal Oil & Gas Co., died Nov. 15 in Balboa, Calif. With company since 1929.

John E. Cullen, dean of the field staff of Distilled Spirits Institute, died Nov. 16 in Baltimore, Md. With Institute since 1938.

Robert Malcolm, Sr., 82, chairman of the board of Chicago Eye Shield Co., died Nov. 27 in Elmwood Park, Ill.

A. S. White, inventor of tiered chlorine cell, died Nov. 29 in Chicago, Ill.

Anthony Hughes Friston, 60, chemist and one of the first employees who started up the first Carbide and Carbon Chemicals plant in South Charleston, W. Va., died Dec. 3. With Union Carbide since 1923.

Harold A. Morrison, 72, senior engineer with Oliver United Filters, died in Pelham Manor, N. Y. With company for 36 years.

Victor F. Palmer, 66, former treasurer of Standard Oil Co. of Calif., died Dec. 3.

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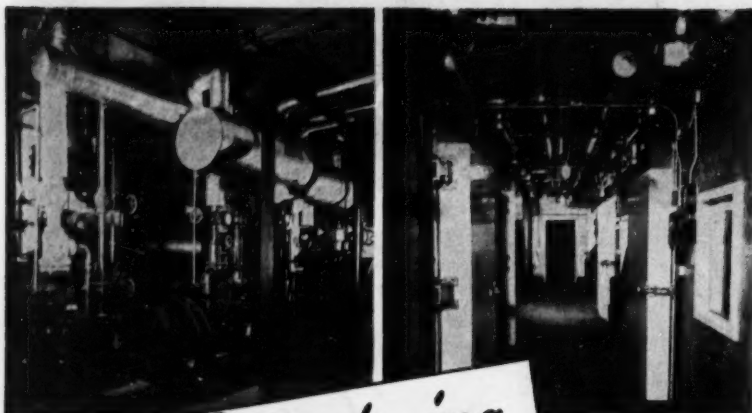
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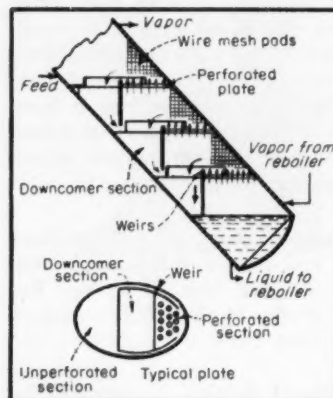
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THIS MONTH'S

Letters:



Tower of Pisa?

Sir:

Is it a symptom of the screwy times? Or the forecast of an oblique trend in chemical engineering? Or am I—prematurely—ripe for the psychiatrists?

I'm referring, of course, to the "tilted" fractionation tower (see drawing above) you described in your Tomorrow's Technology department for December (p. 347).

Sure, I know Standard Oil Development points out in the patent that the "leaning-tower-of-Pisa" design gives downcomer areas of 50-90 percent of the superficial area (5-20 percent in conventional towers). That, of course, points to a terrific increase in capacity.

But I'm still alarmed at the prospect, a decade or so hence, of looking forward to sprawling chemical plants studded with such leaning, Pisa-like fractionating towers. . . .

HERBERT C. CLAY

Design Engineer
Houston, Tex.

► So are we! But that's "tomorrow's technology" for you.—ED.

Pro & Con: Big & Little

Sir:

I've had the September copy of *Chemical Engineering* on my desk for several months as I wanted to thank you for the picture of our

Pro & Con

plant on the cover and on the page following.

It made quite a contrast with the picture alongside. However, we don't want to get that big or the fun would disappear!

PAUL A. GROSS

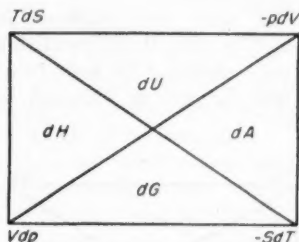
General Manager
Chemical Process Co.
Redwood City, Calif.

► Reader Gross refers to the picture of his firm's plant that we used on the cover of our September issue. It illustrated Editor Reeves' highly-read article "Better Off Working for a Small Company—Or a Big One?" Manager Gross thus casts his vote for the small company and "more fun."—Ed.

Thermo Memory Aid

Sir:

I should like to point out to all readers who enjoyed, as I did, T. E. Corrigan's refresher on Thermodynamic Principles in October that the first eight thermodynamic functions on p. 241 can easily be derived by using the following simple diagram:



At the top corners we have the two terms from the right-hand side of the "First Law" equation $dU = TdS - pdV$ (T, p constant) and at the diagonally opposite corners the differential terms for S and V constant with changed sign.

To complete the diagram, we must place the differentials of energy terms dH , dU , dG and dA into the corresponding sections. This should not be difficult if we remember the bars showing relations of energy terms (Fig. 4, p. 239).

As, for example, H includes TS and pV terms, its differential is

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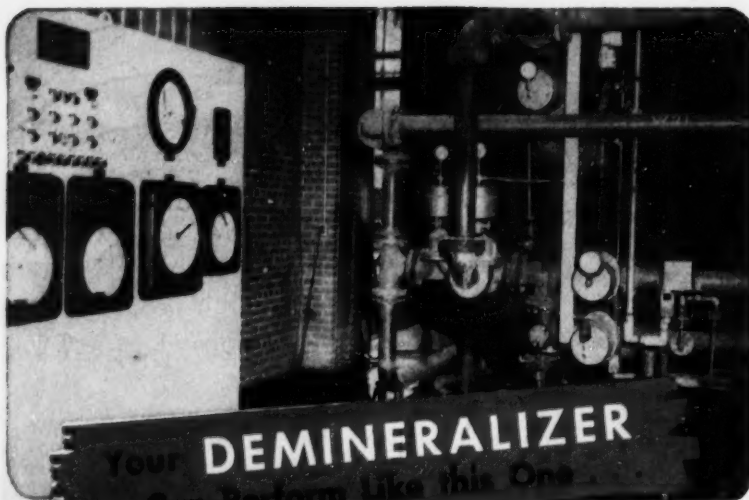
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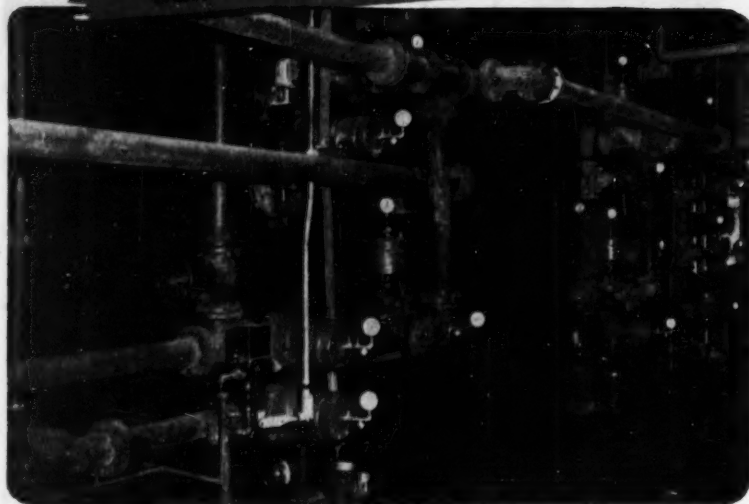
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PRO & CON . . .

placed in the section having both these terms at its corners (i. e. on the left side). Further, as U includes TS but not pV terms, dU finds its place in the top section, etc. Thus the differentials of energy terms are equal to the differentials adjoining each section:

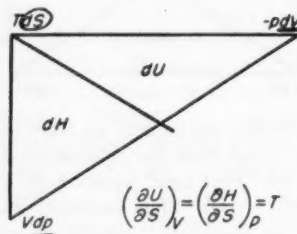
$$\begin{aligned} dU &= TdS - pdV \\ dA &= -pdV - SdT \\ dG &= Vdp - SdT \\ dH &= TdS + Vdp \end{aligned}$$

The first four thermodynamic functions (p. 241) are given by the ratios of differential terms along the parallel sides:

$$\begin{aligned} \left(\frac{\partial S}{\partial p}\right)_T &= -\left(\frac{\partial V}{\partial T}\right)_p \\ \left(\frac{\partial p}{\partial S}\right)_V &= -\left(\frac{\partial T}{\partial V}\right)_S \\ \left(\frac{\partial S}{\partial V}\right)_T &= \left(\frac{\partial p}{\partial T}\right)_V \\ \left(\frac{\partial V}{\partial S}\right)_P &= \left(\frac{\partial T}{\partial p}\right)_S \end{aligned}$$

The symbol for partial differential is used, and as can clearly be seen the variable held constant is contained in the denominator of the opposite side. The sign of the ratio is negative where both differential terms have a minus sign (along the right-hand side in the vertical direction).

The next four relations are formed by using the differentials in sections adjoining the same corner of the diagram, as indicated below:



The differential term of the product of the corner (in circle) is the denominator of the two differentials in the adjoining sections, while the variables held constant in each case are contained in the differential terms at the outside corners of sections involved (underlined). The ratios formed in this way are equal to the first factor (including the sign) of the prod-

uct containing the common denominator.

Similarly the remaining relations can be easily found:

$$\left(\frac{\partial U}{\partial V}\right)_S = \left(\frac{\partial A}{\partial U}\right)_T = -P$$

$$\left(\frac{\partial A}{\partial T}\right)_V = \left(\frac{\partial G}{\partial T}\right)_P = -S$$

$$\left(\frac{\partial G}{\partial P}\right)_T = \left(\frac{\partial H}{\partial P}\right)_S = V$$

B. SULC

Engineer
Northwich, Cheshire
England

► We're glad to pass along Reader Sulc's interesting letter and diagrammatic derivation of the thermodynamic function in Tom Corrigan's "refresher" article for October. Many of our readers will value these derivations as useful memory devices.—Ed.

File More Articles

Sir:

First of all, I wish to congratulate you on the improvement in the caliber and scope of the articles in *Chemical Engineering*. Especially welcome is Dr. Corrigan's "Refresher Course" series. . . .

However, I wish to register a complaint about the layout of your articles. Quite often, after reading an article, I wish to tear it out and file it in a specific folder—only to find, when I turn the page, the beginning of another article. I also wish to file in another folder . . . and I cannot separate them.

I sincerely hope that you can do something about this situation. I'm sure you'd earn the thanks of many others besides myself.

STANLEY GROSSEL

Project Engineer
The Barrett Div.
Allied Chemical & Dye Corp.
Frankford, Pa.

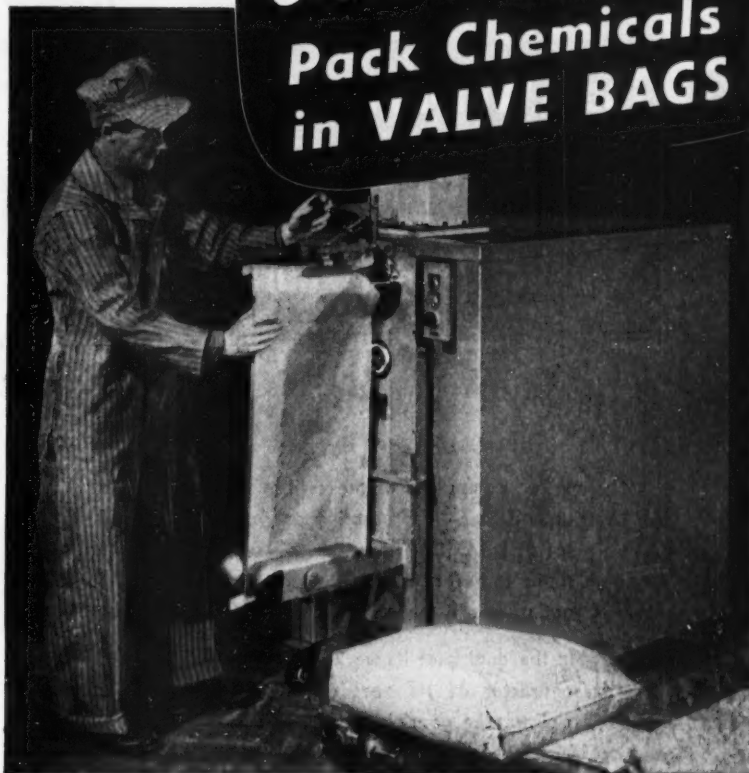
► Engineer Grossel justifiably points out that some of our feature articles have been difficult to file without destroying parts of adjacent articles.

But he wrote his letter just before we put into effect (with our January issue) our plans for making more articles fileable as complete units. Now, wherever possible, we begin a feature article on a right-hand page and end it on a left-hand page—ideal for the reader who wishes to clip and file it.

But this, naturally, isn't always pos-

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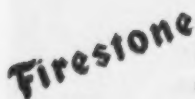
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PRO & CON . . .

sible. In these cases we try to make adjacent articles as dissimilar as possible on the theory that most readers won't object to having at least one of the articles in non-fileable form.

These two schemes, we're confident, will solve the problem of fileability for most readers. But we do intend to keep an eye on the situation and to take further steps if necessary.—E.D.



Mighty Midget

Sir:

The article on p. 218 of your December issue entitled "These Are Production Cyclones" interested me greatly and, I might add, more than paid for my three-year subscription to *Chemical Engineering*!

I still marvel at the fact that these miniature liquid cyclones (see cut), each with a diameter of only 10-15 mm., can handle a flow of 24 gpm. at 113 psi. in 3-stage units. They are, as I understand it, particularly designed for fine size classification in the range of 2-20 microns.

Could you give me more information on the development of these DorrClone units? Incidentally, your item was the first and only time I have seen this development mentioned in any chemical or technical journal. . . .

A. V. BAXTER, JR.

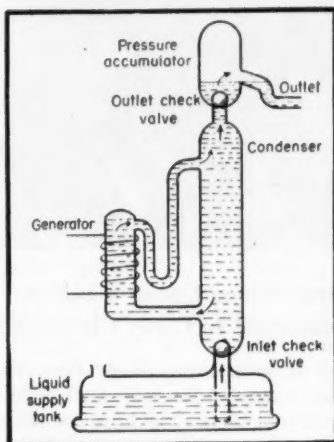
Consulting Engineer
Vancouver, B. C.

► Yes, we've been told that our announcement of these new Dorr units

was the first and only one in U.S. chemical publications.

The DorrClone is a cylindro conical classification unit using centrifugal force in place of gravity. The present midget multiple-unit type was developed by the Dutch State Mines, Limburg, and Dorr Co's associated company in the Netherlands, Dorr-Oliver N. V. The Dorr Co. is exclusive licensee of Dutch State Mines patent rights.

We understand that work is under way to develop smaller units!—Ed.



Heat Pumps Liquids

Sir:

I wish to congratulate *Chemical Engineering* on the job it has been doing recently in presenting latest developments in the field of chemical and related equipment.

Just as an example, I was quite interested in the little item in your *Process Equipment News* department for December, on p. 226, describing the new-type pump that uses heat as a source of energy. Although somewhat limited in applications, I can understand why the unit can be ideal for handling corrosive or dangerous fluids under certain conditions. . . .

MILTON LE SEUR

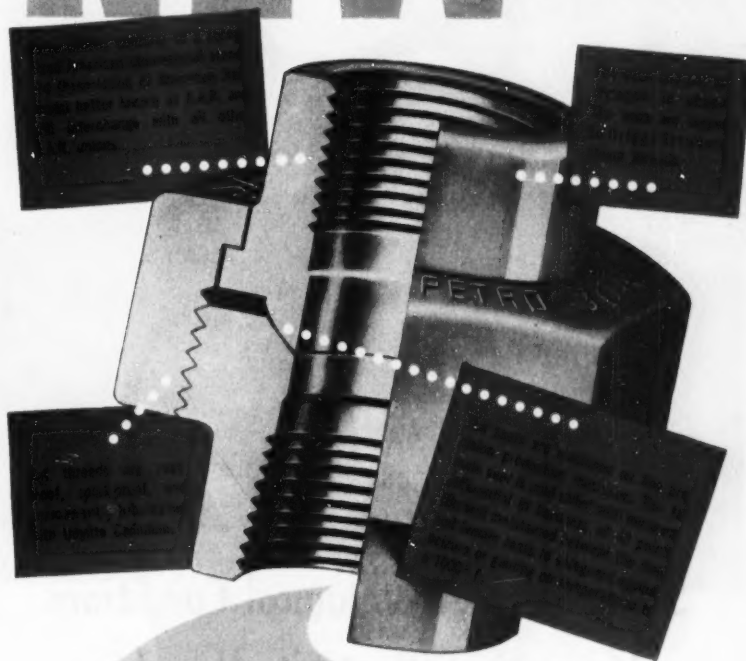
Chemical Engineer
Baton Rouge, La.

► We appreciate these kind words on the job that's being done by Cal Cronan, editor of our *Process Equipment News* department.

The heat-utilizing pump mentioned (see cut) was developed by Jet-Heet, Inc., of Englewood, N. J. It is known as the Thermopump.—Ed.

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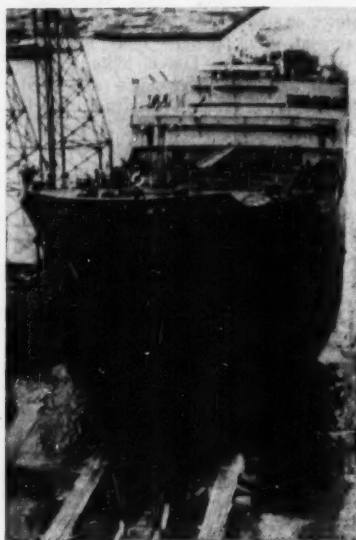
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WHAT'S HAPPENING

(Continued from page 144)



First Ocean-Going Tanker Launched to Carry Chemicals

First ocean-going tanker ever constructed for the transportation of bulk liquid chemicals has been launched at the Quincy, Mass., yard of Bethlehem Steel Co.

Christened the S. S. Marine Dow-Chem, the vessel was sponsored by Mrs. William N. Westerlund, wife of the president of Marine Transport Lines, Inc., of New York, owners of the ship. After completion early in 1954, the tanker will be operated under charter to Dow Chemical Co.

President Westerlund of Marine Transport, which has pioneered waterborne transportation of liquid chemicals, said the launching marked a significant event in the history of the American merchant marine.

While liquid chemicals have been moving by barge and converted ocean-going craft during the past few years, he pointed out that the Marine Dow-Chem is the first ship over specifically designed and constructed for that purpose.

Ships like the Marine Dow-Chem, he added, will be able to transport a wide range of liquid chemicals safely, speedily and economically from the large producing centers in the Gulf area to the big consuming centers on the eastern United States coast.

Economies expected to develop from such movement should lead to the expansion of demand for these products, particularly for the plastics industry, he said.

A single-screw turbine-driven vessel with a speed of about 15 knots, the Marine Dow-Chem is a 16,500-ton deadweight tanker with an over-all length of 551 ft., breadth of 68 ft. and depth of 37½ ft.

Outwardly, she resembles a conventional petroleum tanker. However, she has many special features to meet the unusual problems encountered in transporting liquid chemicals, including synthetic organic compounds, inorganic acids and caustics.

To make certain that her cargo, which will consist of a number of different chemicals at the same time, will have the same high degree of purity when delivered ashore as when originally loaded, the Marine Dow-Chem has segregated tank, piping, pumping and venting arrangements, and other special equipment. The possibility of contamination of cargo is further reduced by special lining of some tanks.

Because some of the specific gravities of the chemicals being carried are higher than that of petroleum, dimensions of some of the structural members are greater than those of the normal oil tanker.

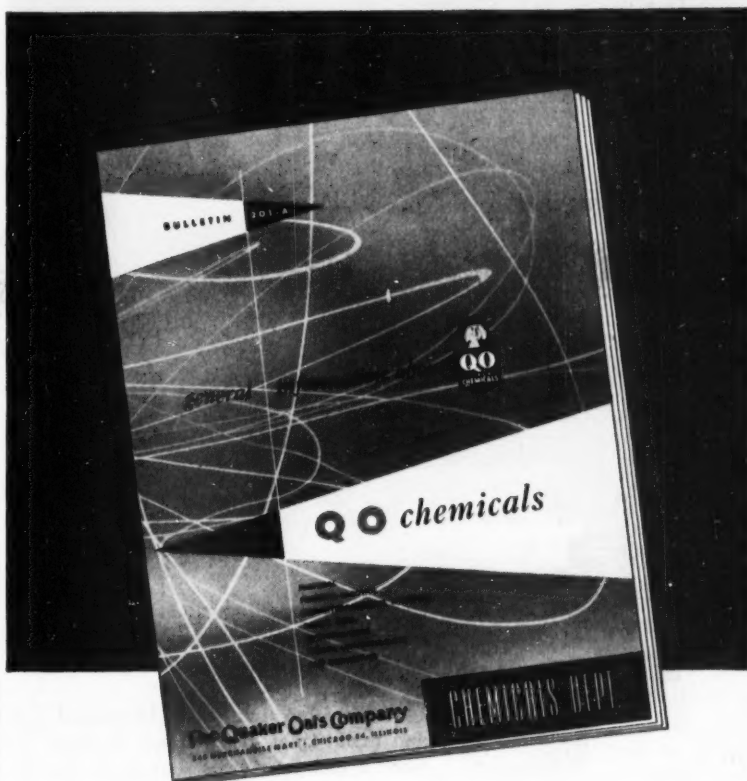
Pennsalt Offers Pulp Mills Chlorine Dioxide Bleaching

Pennsylvania Salt Manufacturing Co. is offering pulp and paper mills a chlorine dioxide generation and bleaching system. Pennsalt engineers will furnish pulp and paper makers with technical information on all equipment and chemicals used in the process.

Pennsalt developed the chlorine dioxide generation process because of its basic position as a producer of chlorates, one of the essential chemicals in the process. The company has been supplying chlorine and other chemicals and specialties to the pulp and paper industry for over 50 years. Pennsalt and its clients have been granted patent immunity rights on certain features of the system under an agreement with Mathieson Chemical Corp.

The chlorine dioxide generator is designed for economical installation and, because of its relatively small

Write for your copy!



NEW Quaker Oats' Bulletin 201-A

General Information about QO Chemicals

This bulletin—just published—is about furfural, its derivatives, and associated products, and includes practical information on commercial handling, physical data, chemical reactions and established uses.

The QO furfural family of commercial and semi-commercial products, now available, consists of furfural, furfuryl alcohol, tetrahydrofurfuryl alcohol, furoic acid, hydrofurfamide, and Furfal*.

In addition to the products mentioned above, this bulletin discusses other furfural-derived chemicals available in commercial lots.

The Quaker Oats Company

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These valve stems must be packed and made tight at all times. A drip from a leaky valve is dangerous to personnel. These acid valves require

$\frac{1}{8}$ ", $\frac{3}{16}$ ", $\frac{1}{4}$ ", $\frac{5}{16}$ " or $\frac{3}{8}$ " square packing. Up to now braided blue asbestos packing has been considered best and cheapest (60-day life). Today the whole world of packing has been changed by the material "Teflon". Braided yarn packing made of Teflon is replacing all forms of braided packing for acid service because it lasts as long as the valve itself. Practically no acid, diluted or concentrated, hot or cold, has any effect on the packing. (Many records of two-years' service or more have been reported). This is highly important to all Chemical Engineers and Chemical Plant Operators.

"JOHN CRANE" Style 704 is available in handy coil or spool form in a full range of sizes. A stock of "JOHN CRANE" Braided Teflon Packing in your storeroom may be a life saver for you.

Teflon is recommended on chemicals at any pressure with temperatures ranging from -100°F. to +500°F.

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*Du Pont's trademark for tetrafluoroethylene resin.

JOHN CRANE

CRANE PACKING COMPANY

WHAT'S HAPPENING . . .

size, it is possible to house it within the existing buildings of most bleach plants.

The generator itself consists of one lined steel tank. The process operates continuously. However, generation may be stopped or started at will, and the rate of generation may be varied as required by changing the feed rate of chemical supply.

Automatic controls eliminate any need for additional labor or specially trained operators. The design of the generator safety valves plus the automatic controls supply the safety factors that have made this process commercially practical.

Use of chlorine dioxide in addition to present bleaching processes makes possible a higher degree of pulp refinement and greater brightness without damaging the strength characteristics. It also reduces shrinkage during the refinement operations. Woods not otherwise suitable can be used for the production of certain types of bleached pulp.

So that mill operators can observe the chlorine dioxide generation process and actually try this bleaching chemical in their own plants, Pennsalt has constructed a portable pilot plant that can be set up in mills for trial runs. Output of this pilot plant can be used for pulp bleaching on an experimental or laboratory scale. The chlorine dioxide is generated from acidified chlorates by the reducing action of sulfur dioxide.

Alcoa Tests Power Plant at Texas Aluminum Smelter

First boiler and turbo-generator unit of the Sandow power plant has been given its first trial run at the new Rockdale, Tex., plant of Aluminum Co. of America. The Sandow power plant, operated by Industrial Generating Co., will furnish the large quantities of electric power needed to smelt aluminum at Alcoa's Rockdale plant.

Construction of lignite processing facilities necessary to operate one boiler is also nearly complete. Before the initial power unit can be placed in operation, however, the lignite handling and processing equipment must be aligned and exhaustive tests completed. During trial operations,

fuel oil will be burned in the steam boilers instead of lignite.

When complete, the Sandow power plant will have three generating units, each capable of producing 80,000 kw. The second and third power units are expected to be in operation early this year, at which time the Rockdale plant can place all of its aluminum producing facilities in operation.

Much construction remains to be done and, as J. D. Harper, manager of the Rockdale plant, explains, due to the experimental nature of the lignite processing facilities it is difficult to tell exactly when the first electricity will be generated at the new power plant.

"If the boiler and turbo-generator pass these first tests satisfactorily and the lignite handling equipment performs as we hope it will, we should have the initial unit in commercial operation before the first of the year," Harper said.

Texas Power & Light Co. has supplied the Rockdale plant with enough surplus power during the past year to operate two of the four potlines.

Growing Market Foreseen For Tall Oil in Industry

Production approaching 1,000 tons a day of crude tall oil within the next few years is predicted by President A. Scharwachter of the Tall Oil Association. Present production of tall oil, which comes from the pine wood used in making kraft paper, is approximately 200,000 tons yearly.

Although tall oil is relatively new among industrial oils, Scharwachter, who is also vice president of Arizona Chemical Co., told members of the Tall Oil Association recently at the Cloister, Sea Island, Ga., its U. S. production and uses have increased steadily since its introduction in 1930. Commercial acceptance and use of tall oil have been achieved gradually.

Demand for tall oil rosin exceeds the supply, Scharwachter pointed out. In addition, this increasingly available industrial oil has further potentials in the manufacture of linoleum, paints, soaps, cleansers, adhesives, asphalt emulsions, core oils, fungicides, varnishes, textile oils and many others.

Scharwachter also predicted that tall oil, a natural mixture of rosin



The extent to which metal will corrode in atmosphere—or even whether it will corrode at all to any appreciable degree—is determined primarily by the moisture content of air. While deterioration at normal temperatures and humidities of less than 35% is so slow as to be almost negligible, the rate accelerates rapidly beyond a critical point of approximately 65%. This activity is intensified when such contaminants as hydrogen sulfide or sulfur dioxide are absorbed from industrial atmospheres. Impingement of solids, which tends to hold this acid film in contact with metal, localizes and further advances corrosive attack.

When exposure to atmosphere includes also exposure to sunlight and to the variables of weather, the situation becomes more complex. Such factors as the composition of metal and of the protective rust film that forms upon it, the length of time surfaces are wet, the extent

to which they retain moisture, and whether they may be bared intermittently by heavy rainfall are influential in determining metal life.

An understanding of the mechanism of corrosion in all of its varied phases is an obvious requisite to prescribing methods of control. Thirty-five years' study and evaluation of industrial corrosion problems and the formulation of protective coatings to meet them has taught us something about corrosion and the ways in which it may be checked successfully.

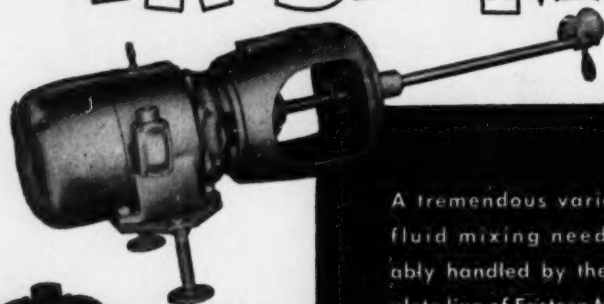
We are ready to share that knowledge with you in an analysis of any metal-maintenance problem you feel requires the *different* approach of considered engineering judgment . . . to give you a recommendation you can be sure is technically correct and practically workable—for quality protective surfacing that is right for you because it is individually job-selected to meet your service specifications.



100-1

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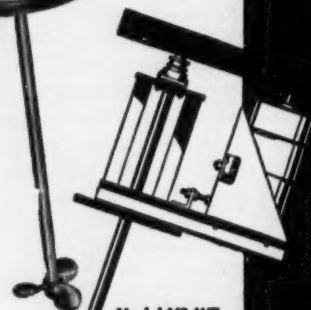
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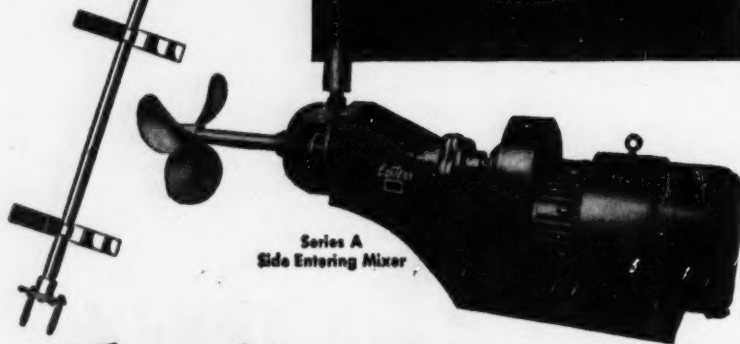
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WHAT'S HAPPENING . . .

acids related to abietic acid and of fatty acids related to linoleic and oleic acids, will prompt many new chemical uses within the next five years.

L. J. Doyle, vice president of Union Bag & Paper Corp., who is a former president of the Tall Oil Association, called upon tall oil industry to intensify research toward the development of end uses. He emphasized that the kraft paper industry, from which the tall oil industry derives, is healthy because of the time, money and effort it has put into such research work.

Tall oil is such a low-cost, readily available raw material, Doyle said, that it is attractive to potential users. He said it should be tall oil industry's purpose to show all industry how to use this versatile source of organic acids.

Texas Enterprise Will Tap Vast Mexican Sulfur Finds

In an important new sulfur producing venture, United States capital and technical skill will help to tap Mexican sulfur sources in the Isthmus of Tehuantepec in the state of Veracruz. Texas International Sulphur Co., with headquarters in Houston, Tex., has signed an agreement with Central Minera, S. A., of Mexico City, holder of vast fields in Tehuantepec under contract with the Mexican government. The two organizations will team to develop these sulfur holdings.

Victor Dykes, president of Texas International Sulphur, and Jose Corral, general administrator of Central Minera, signed the agreement. Under the contract TIS received the right to explore the sulfur deposits of Central Minera.

High-grade native sulfur is present in Tehuantepec in huge commercial quantities. Already three U. S. companies have proved enough sulfur to warrant erection of multi-million dollar plants employing the Frasch process of sulfur extraction.

Mexican Gulf Sulphur Co. has completed a plant and will produce 200,000 tons of sulfur per year, and Pan American Sulphur Co. plans to construct a Frasch plant.

Many other companies, including large U. S. interests, have tried to gain

sulfur mining rights from the Mexican government in Tehuantepec and have been denied.

The geology of Tehuantepec matches that of Texas and Louisiana, where more than 80 percent of the world's sulfur is now being produced—the only such match now known in the world.

Domes at San Cristobal in Tehuantepec may be the largest in the world. Mexico may become second only to the United States as a sulfur producer by 1954.

Central Minera's contract with the Mexican government gives it the right to explore 123,818 acres and to produce sulfur from 14,826 acres. The agreement provides for a "floating concession" of 16,818 acres, which entitles Central Minera to select this land for sulfur exploration anywhere in the Mexican national reserve in Tehuantepec, excluding land already under contract to other companies.

The rest of the concession, 106,732 acres, has already been staked out by Central Minera. This land is in seven different lots, some of which adjoin the producing areas of other companies.

Texas International Sulphur was organized in February 1953 to finance and direct sulphur development in Mexico. TIS will build a plant, using the autoclave process, near San Felipe, Baja California, in Mexico. It will process sulfur on its properties contracted with the Mexican government in that area.

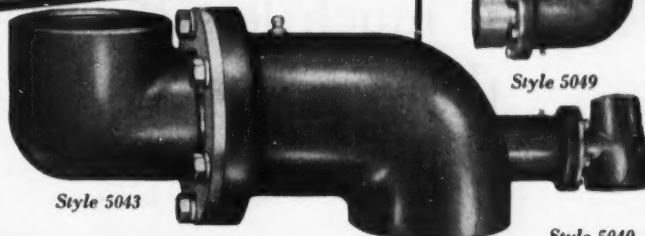
Phosphorus Compound Combats Fouling

Its new gasoline additive, a haloalkyl phosphorus compound that controls ignition and overcomes spark plug fouling, will be introduced to the oil industry by Ethyl Corp. Commercial shipments are just beginning.

The ignition control compound will be marketed to the oil industry for blending with gasoline. It will be sold for 40c. a lb. in carload lots and for 41c. a lb. in less than carload lots. Shipments will be made in 55-gal. non-returnable steel drums, delivered in the U. S. freight prepaid.

A product of Ethyl research, the new haloalkyl phosphorus compound will be manufactured by a process also developed by Ethyl. Tests have shown it to be the most effective compound

BARCO SWING JOINTS



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BARCO'S new, attractively priced, all-steel ball bearing *Swing Joints* are designed specifically to provide for movement and flexibility in metal pipe loading or unloading lines handling petro-chemicals, oil, alcohol, and other fluids.

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SIMPLE CONSTRUCTION—Joints can be disassembled for inspection without disconnecting piping. O-rings are easily renewable in the field.

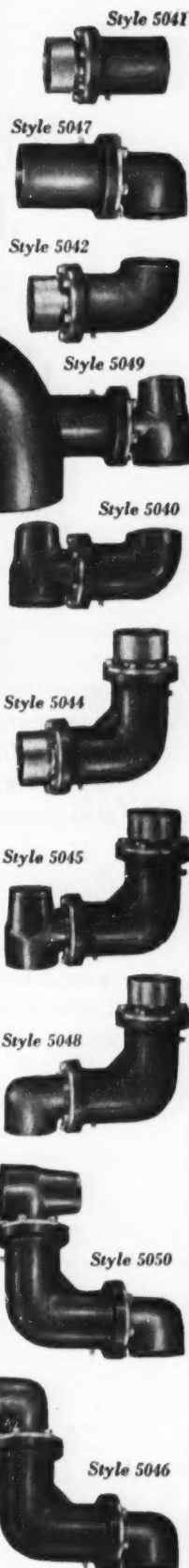
ENGINEERING RECOMMENDATION—Barco will be glad to give you detailed recommendations on joints to use and suggested arrangements for complete loading and unloading assemblies.



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BARCO—The Only Truly Complete Line of Flexible Ball, Swivel, Swing, and Revolving Joints

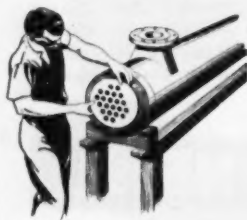


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Corrosion costs do not end simply with equipment replacement. A complete analysis must include shutdowns, lost production time, product contamination and spoilage, fume damage to buildings and associated equipment, possible injury to personnel. Compare this myriad of costs against the single outlay for Tantalum, the metal that is not merely "corrosion-resisting", but acid-proof.

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WHAT'S HAPPENING . . .

investigated by Ethyl for the control of spark plug fouling and preignition.

Preignition is one of the major obstacles to more efficient utilization of gasoline. Both preignition and spark plug fouling are caused by deposits that accumulate in an automobile engine under conditions of low-speed city driving. These deposits may cause spark plugs to misfire. They also lead to preignition or wild ping, in which the fuel charge is ignited independently of the spark plug.

Its new additive, Ethyl claims, corrects these conditions quickly and effectively. Two to three tanks of gasoline treated with the additive are sufficient both to control preignition and to return fouled spark plugs to normal operation. The compound will go to work on deposits already accumulated in an engine, without the need of first removing the spark plugs or cleaning out the deposits.

Its ignition control compound, Ethyl points out, is separate and distinct from antiknock compound, whose principal ingredient is tetraethyl lead. Both products have different jobs to do in gasoline, and will be marketed separately to the oil industry. Tetraethyl lead increases the ability of the fuel to produce power by increasing its octane number, while the ignition control compound corrects spark plug fouling and the abnormal combustion caused by preignition.

Together with modern refining processes and the use of tetraethyl lead, the addition of its new ignition control compound, Ethyl believes, will enable refiners to produce the most efficient gasolines economically, and to overcome the problems of preignition and spark plug fouling.

Oregon State Expanding Chemical Engineering

A new chemical engineering building for Oregon State College has been approved by the Oregon legislature, and the building is now being designed. It is expected to be ready for use by September 1955.

Design will include separate facilities for research in such fields as wood, fuel, plastics, metallurgy and electrochemical technology. The new-

est features based upon the experience of other schools will be incorporated in the new building.

In addition to facilities for undergraduate research, says J. S. Walton, head of chemical engineering at Oregon State, it will include several private rooms for graduate students, as well as control laboratories and unit operations laboratories.

Chemical Market Research Course Starts at Delaware

A new course in chemical market research will be offered by the University of Delaware, Newark, Del., beginning Feb. 9, 1954, it is announced by Robert L. Pigford, chairman of the department of chemical engineering. The course is sponsored jointly by the departments of chemical engineering and economics. Olaf P. Bergelin of the chemical engineering faculty will be coordinator. The course will be offered through the extension division.

Impetus for the course in chemical market research came from the Chemical Market Research Association. Richard E. Chaddock of Hercules Powder Co. is chairman of the CMRA's education committee, and helped to enlist the interest and support of the 13 industries from which the lecturers will come.

The University of Delaware course will be a pioneering effort in the teaching of chemical market research since only one other course has been offered previously—at the Case Institute in Cleveland, Ohio.

Meetings for the University of Delaware course are scheduled for Tuesday evenings, beginning February 9 and continuing weekly excepting March 2 and April 6. All meetings will be held in the board room, Board of Education building, 511 West 8th St., Wilmington, Del.

The course will carry two semester hours of upper division credit or graduate credit for qualified students. Those not desiring credit may register as auditors. The fee will be the same for both. Registrations are being accepted by the Division of University Extension, University of Delaware, Newark.

Dr. Bergelin, course coordinator, has announced the following lecturers for the new course: R. B. Wittenberg, general manager, General Tire



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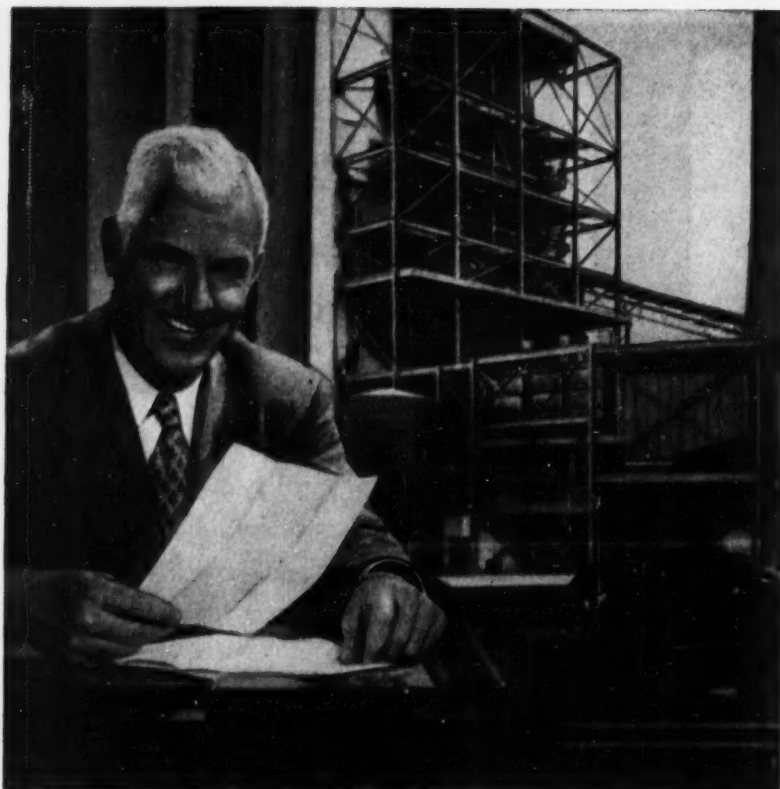
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Interhandel to Appeal Dismissal by U. S. Court

Interhandel, Swiss investment corporation, will appeal a United States District Court decision dismissing the Swiss firm's suit for recovery of its 90 percent stock interest in General Aniline & Film Corp. The U. S. Alien Property Custodian has held General Aniline since 1942.

"The judge himself conceded that his decision is unprecedented," declares John J. Wilson, attorney for Interhandel. "Interhandel has made every imaginable effort to produce the records called for, and up to the time of the judge's decision we had produced 63,658 original documents. Under the circumstances, we regard the decision to dismiss our suit as contrary to law."

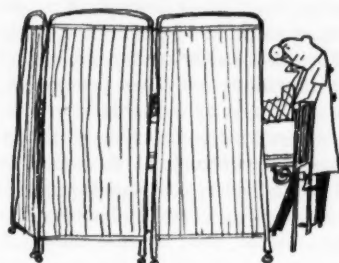
Butyrates: Use of butyrate plastics that can be peeled off, according to C. H. Penning of Eastman Chemical Products, Inc., cushions jet engine turbine blades and other highly critical parts for the Air Force and the Navy. The slightest scratch on these precision pieces means rejection. The transparent butyrate not only protects these surfaces but enables identifying data on the blades to be read without peeling off the coating. Pen-

ning foresees use of butyrate plastics in the packaging of small precision bearings now packed in glass vials. The glass vials might be replaced by cellulose acetate containers coated with butyrate. This would give a stronger package, lighter in weight and costing less.

Nickel Sulfate: Republic Chemical Corp. is now producing nickel sulfate in a new unit at its Curtis Bay, Md., plant. Annual output will be 4 million pounds. Nickel sulfate, currently scarce and being imported from abroad, is used in nickel plating, textiles, ceramics, tallow and oil refining, and in other industries.

Rocket Fuels: B. F. Goodrich Co. has built a new laboratory at its Brecksville, Ohio, research center for basic research in rocket propellants. Investigations are currently under way there.

LITTLE BONER



Curiosity Can Kill a Cat

A research chemist was gently heating a small amount of perchloric acid in a usual laboratory hood lined with stainless steel.

The hot plate was on low, so he put a doubled-up paper towel across the top of the beaker to help hold its heat. Somehow the paper caught fire and a small piece dropped to the floor of the hood.

There a thin scaly deposit of something began to show a beautiful red glow about the size of a silver dollar.

Did the chemist put the glow out? He really meant to, but (being a very curious fellow) he got fascinated by the unusual glow.

Three weeks later they let him out of the hospital.

If you know of a true "little boner"—especially if it's more amusing than this one—why not send it to the Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y. We don't mention names!

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THIS MONTH'S

Technical

Complete Coverage

FIVE-MEMBERED HETEROCYCLIC COMPOUNDS CONTAINING NITROGEN AND SULFUR OR NITROGEN, SULFUR AND OXYGEN (EXCEPT THIAZOLE). By L. L. BAMBAS. Interscience Publishers, Inc., New York. 403 pages. \$14.

CONDENSED PYRIDAZINE AND PYRAZINE RINGS (CINNOLINES, PHTHALAZINES AND QUINOXALINES). By J. C. E. SIMPSON. Interscience Publishers, Inc., New York. 394 pages. \$12.50.

Reviewed by A. H. Blatt

Both of these volumes should prove useful to every chemist who has occasion to look for information about individual members of the heterocyclic systems considered, for the amount of detailed information assembled in the two volumes is enormous. Each volume contains, for each heterocycle system included, a description in the text of methods of preparation, properties, chemical behavior, and uses of the important individual compounds. In addition numerous tables record detailed information on either all the individual compounds in the series or all the individual compounds prepared since a given date. The reviewer is awed by the industry that these volumes represent and, for the areas with which he is personally familiar, can testify to the completeness of the coverage of the literature.

The two volumes have in common their usefulness as sources of specific information. In other respects they are strikingly different. The volume on condensed pyridazine and pyrazine rings deals with just three groups of heterocyclic compounds (cinnolines, phthalazines and quinoxalines) for each of which there is either a substantial chemical literature or on which there has been considerable research since 1940 because of possible applications as antimalarial agents. The author, therefore, has had a relatively compact and substantial body of information to deal with and he has had the additional advantage of being one

Bookshelf

L. B. Pope

of the principal contributors to the development of the chemistry of cinolines. The book is unusually well written, and it should serve admirably as a stimulus to further research for one cannot read the book without having scores of problems suggest themselves.

The volume on the five-membered heterocycles deals not with a compact but with a sprawling mass of information. Some of the heterocyclic systems included have been the subject of much work (e.g. the 1,2-benzisoxazoles, of which saccharin is a member); others have been the subject of very little work (e.g. the 1,3,5-dithiazoles, of which only one member has been reported). To deal with this situation the author has adopted the procedure of describing the chemistry of a group of compounds and then offering a critical survey of the material presented. Because of the nature and diversity of the material included, it is understandable that this volume does not read so smoothly as does its companion. Also because of the nature of the material this volume, rather than suggesting particular problems that need study, makes it clear that the basic chemical behavior of many of the series of heterocyclic compounds described requires exploration.

Three minor errors in the volume on five-membered heterocycles should be noted. On p. 217 the subheading is 1,3,4-dithiazole and the one compound mentioned is named as a 1,3,4-dithiazole. The structural formulas and their numbering indicate, however, that the names should be 1,3,5-dithiazole. On p. 227 the heterocyclic

RECENT BOOKS RECEIVED

Fiber Microscopy. By A. N. J. Heyn. Interscience. \$5.50.

Industrial Inorganic Analysis. By Roland S. Young. Wiley. \$5.75.

Modern Electroplating. Ed. by Allen G. Gray. Wiley. \$8.50.

Nuclear Moments. By Norman F. Ramsey. Wiley. \$5.

Procedures in Experimental Metallurgy. By A. U. Seybolt & J. E. Burke. Wiley. \$7.

Silicones and Their Uses. By Rob Roy McGregor. McGraw-Hill. \$6.

CHEMICAL ENGINEERING—February 1954

Bayley

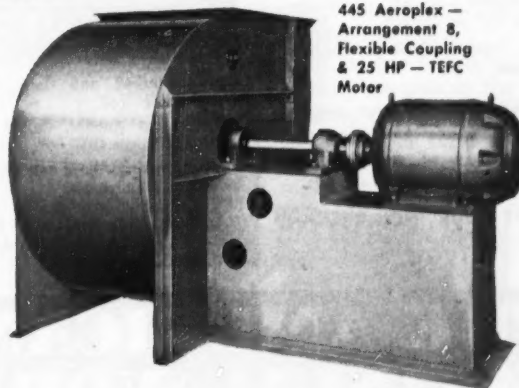
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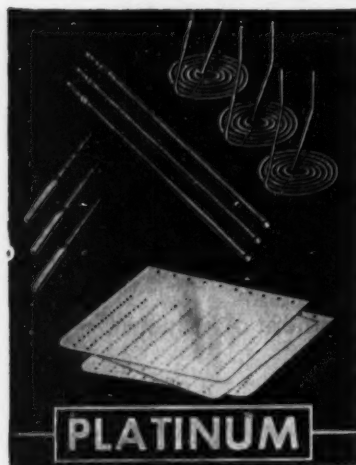
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system that is elsewhere correctly called thianaphthene is called thianaphthalene. And on p. 326, the statement that "the Ag salt (of saccharin) exists in both forms (OAg and NAg) since alkylation of the silver salt gave both the N- and the O-substituted compounds" represents an unacceptable conclusion.

Functional Group Analysis

ORGANIC ANALYSIS, Vol. I.
Edited by J. Mitchell, Jr.,
I. M. Kolthoff, E. S. Proskauer and A. Weissberger.
Interscience Publishers, Inc.,
New York. 473 pages.
\$8.50.

Reviewed by M. Auerbach

Here we have the first of a series of volumes in which the editors plan to "acquaint the student with the field of organic quantitative non-elemental analysis . . . evaluate critically the many procedures employed . . . provide the practicing chemist with a reliable survey of these important methods . . ."

The present volume (as well as the next few to be published) deals with functional group analysis. It consists of eight monographs and one general review. Each section is written by a person well known in his field. A. Elek contributes what is probably a definitive treatment of the determination of alkoxyl groups. V. C. Mehlenbacher crowds a great deal of useful information in 65 pages on the determination of hydroxyl groups. A fine paper on the determination of the alpha-epoxy group is contributed by J. L. Jungnickel, E. D. Peters, A. Polgár and F. T. Weiss. The literature on the analytical uses of the Grignard reagents is summarized by G. F. Wright. In a 45-page chapter, F. G. Arndt presents what must be called an orientating survey on methylation with diazomethane, especially in connection with structural or identification studies.

A comparatively large section is contributed by J. Mitchell, Jr., on the determination of carbonyl and

acetal compounds. Available methods for the determination of organic sulfur groups are described and evaluated in an excellent chapter by S. Dal Nogare.

The final chapter, by N. D. Coggeshall, deals with "Spectroscopic functional group analysis in the petroleum industry." Instead of concerning himself with the analysis of selected functional groups, or the utility of a given reagent, Coggeshall reviews the wide field of molecular spectroscopy. His treatment is scholarly as well as technical, and will be of interest to all analysts—not merely those in the petroleum industry. It is to be hoped that in succeeding volumes, the editors will use Coggeshall's paper as an introduction from which the several branches of analytical spectroscopy will be developed individually.

This first volume of Organic Analysis makes a good reference book for the functional groups discussed. Each chapter is well documented with references to the original literature. A general subject index is also supplied. The binding is good and the typography excellent.

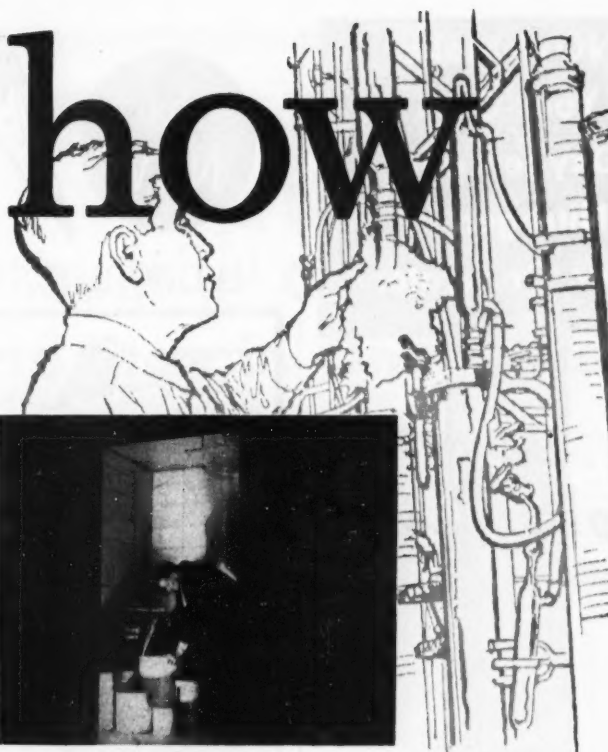
Streamlined Primer

PRACTICAL CHROMATOGRAPHY. By Robert C. Brimley and Frederick R. Meredith. Reinhold Publishing Corp., New York. 128 pages. \$5.

Reviewed by F. C. Nachod

If a technique new finds applications in many diverse fields, workers who are planning to employ it wish for a "primer." This booklet by Dr. Barrett and the late Dr. Brimley fills the bill most adequately.

It painlessly leads the reader from general chromatography to partition and paper chromatography and ion exchange. Emphasis is placed on technique and apparatus while the treatment of theory and literature references are somewhat sketchy. This lack of completeness, however, is no shortcoming but helps in making a streamlined primer which can be warmly recommended to all neophytes in chromatograph.



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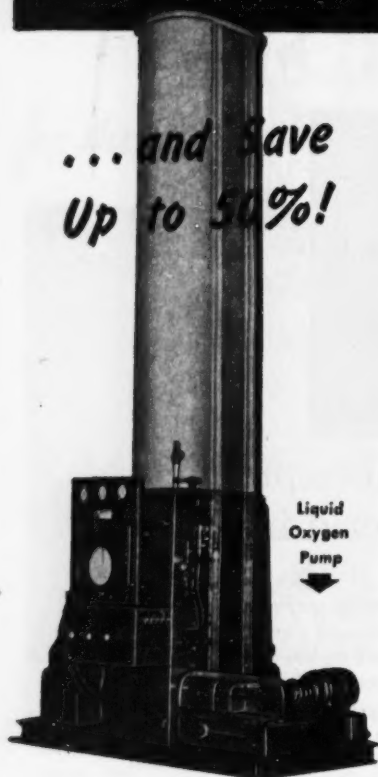
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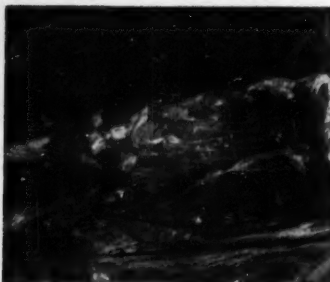
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reported to have been perfected by the Seagrave Corporation of Columbus. Unlike ordinary fire-fighting apparatus, the new truck is designed to snuff out oil field and refinery fires any one of three ways; by squirting out 2800 gallons of water a minute, 1300 pounds of dry chemical compounds, or 19,000 gallons of fire-smothering "foam". In an emergency, all controls on the 20,600 pound unit can be operated by one man.



To utilize low grade ores previously stock-piled, Kaiser Engineers has designed and built a new beneficiation plant at Eagle Mountain Mine, California. The new plant will increase the iron content of the ore shipped and thus further reduce the operating costs of the West's only completely integrated steel plant, 163 miles away. Incidentally, 51 miles of this distance is over the standard gauge railroad designed by Kaiser Engineers to cross the Southern California desert and connect the mine with the tracks of the Southern Pacific.



Temperature Measurement in Engineering, described as a "how to" book for the proper design, performance, and operation of temperature measurement installation, has just been published by Wiley. The authors of the new book are H. Dean Baker, E. A. Ryder and N. H. Baker.



Kaiser Engineers has a large staff of engineering and construction experts ready to tackle your problems in all fields of design, engineering and construction. Call or write: Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

THIS MONTH'S

Recent Books

Standards

Illustrated booklet, traces the history of standards from the year 1120 down to the present time. Defines standards as common language of industry for performance and acceptability. 18 pages.

"Through History with Standards." American Standards Association, 70 East 45th St., New York 17, N. Y.

Natural Gas

A report on the history, commercial use and energy use patterns of natural gas in the Pacific Northwest. Also includes a market survey for future use of natural gas in that area. 110 pages.

"Natural Gas in the Pacific Northwest—Some Economic Aspects," by William Iulo. Bulletin No. 25, Nov. 1953, State College of Washington, School of Economics and Business, Pullman, Wash. \$2.50.

Income Distribution

A report by the Department of Commerce on the distribution of income in the U. S. for 1944, 1946, 1947 and 1950. Shows number of consumer units at successive income levels. Also aggregate income for each income level; together with an analysis of the data. 86 pages.

"Income Distribution in the United States, By Size 1944-1950." Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 65 c.

Food Chemicals

Illustrated booklet, explains role chemistry plays in production and processing of foods. Uses for fertilizers, agricultural chemicals and chemical preservatives are summarized. 6 pages.

"Your Food and Chemical Research. Manufacturing Chemists' Association, Inc., Washington 5, D. C.

& Pamphlets

Piston Ring Corrosion

Results of research on piston wear. The effect of fuels of various sulfur contents and effect of varying water jacket temperatures were investigated—all with the aid of radioactive tracers. Major result is that corrosion is an important wear factor below 150 deg. F. 29 pages.

"The Effect of Fuel Sulfur and Jacket Temperature on Piston Ring Wear as Determined by Radioactive Tracer." Bulletin No. 33, Engineering Experiment Station, Oregon State College, Corvallis, Ore. 40 c.

Hydrocarbon Gasification

Results of a pilot-plant investigation of the catalytic cracking of hydrocarbons of low molecular weight—in the presence of steam and air—producing various types of manufactured and natural gas. 44 pages.

"Catalytic Gasification of Hydrocarbons to Produce Utility Gases." Research Bulletin No. 6, Institute of Gas Technology, 17 West 34th St., Chicago, Ill. \$5.

Waste Water Reclamation

A detailed investigation, in California, on one phase of waste water reclamation—that of recharging underground water basins with waste treatment plant effluent by means of spreading ponds. Report includes study of rates of percolation, optimum spreading periods and cost of spreading. 124 pages.

"Waste Water Reclamation in Relation to Underground Water Pollution." June 1952. State Water Pollution Control Board, 721 Capitol Ave., Sacramento 14, Calif.

Tariff Policy

Booklet states the position of the Synthetic Organic Chemical Manufacturers Association on U. S. foreign economic policy. Stresses the essentiality of the domestic synthetic organic chemical industry

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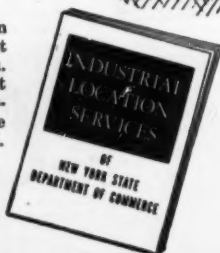
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BOOKLETS . . .

and the importance of tariff policy. 231 pages.

"Trade Strength and Security." The Synthetic Organic Chemical Manufacturers Association, 41 East 42nd St., New York 17, N. Y.

Preheater Corrosion

Corrosion and deposit accumulation in the air preheaters of boilers have been studied in extensive field tests. Tests, both qualitative and quantitative, were carried on over a 5½ yr. period. Illustrated. 23 pages.

"Corrosion and Deposits in Regenerative Air Preheaters." Report of Investigations 4996, Publications Section, Bureau of Mines, 4800 Forbes St., Pittsburgh 13, Pa. Gratis.

Imports

Tariff levels in 1952 were studied to determine the effect of trade agreement concessions. This report is similar to the 1951 report based on 1949 imports, 76 pages.

"Effect of Trade Agreement Concessions on United States Tariff Levels Based on Imports in 1952." U. S. Tariff Commission, Washington 25, D. C. Gratis.

Organics

Comprehensive analysis of the inter-industry relations of the organic chemicals industry. Shows inputs and net outputs of various classes of chemicals. 137 pages.

"Industry Reports: The Organic Chemicals Industry; A Manufacturing Sector in the 1947 Inter-industry Relations Study." Bureau of Labor Statistics, Report No. 35, U. S. Dept. of Labor, Washington 25, D. C. Gratis.

Pest Control

An outline of the use of aerosols to control insect pests in industrial establishments. Contains basic data to aid selection of proper materials and equipment. 4 pages.

"Directions for Industrial Use of Aerosols." Publication E-835 (Revised), U. S. Bureau of Entomology and Plant Quarantine, U. S. Dept. of Agriculture, Washington 25, D. C. Gratis.

Water Conditioning

A handbook which provides a basic background for the engineer and chemist working with water conditioning problems. The initial chapters deal with basic water treatment processes. A supplementary section is devoted to water analyses and their interpretation. 248 pages.

"Betz Handbook of Industrial Water Conditioning." Fourth edition. W. H. & L. D. Betz, Cillingham and Worth Sts., Philadelphia 24, Pa. \$3.

Methane-Ethane Data

Pamphlet gives liquid-vapor equilibria, gas phase pressure-volume-temperature relationships and saturated liquid and vapor density data, for methane-ethane system. Data are in the form of tables and graphs. 40 pages.

"Physical-Chemical Properties of Methane-Ethane Mixtures." Research Bulletin No. 22, Institute of Gas Technology, 17 West 34th St., Chicago 16, Ill. \$3.50.

Liquefied Petroleum Gas

Pamphlet covers safety precautions for LP gas. Includes composition, properties and behavior of the gas. Information is also given on safe storage, handling, transportation and use. 60 pages.

"LP Gas—Safe Handling and Use." Association of Casualty and Surety Companies, 60 John St., New York 38, N. Y. 25 c.

Paint Testing

A historical summary of fifty years work by ASTM Committee D-1 in the field of paint testing. Sixteen papers covering a wide range of topics—including drying oils; shellac; protection of iron and steel. 52 pages.

"Fifty Years of Paint Testing." ASTM Special Tech. Pub. No. 147, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. \$1.25.

NEED A LIGHT WEIGHT, CORROSION- PROOF STRUCTURE?

...your answer may be

Ampcoflex

...EXHAUST SYSTEMS

...DUCTS

...DIPPING BASKETS

...TANKS

AMPCOFLEX is both a corrosion-proof and self-supporting material that provides extraordinary service under adverse plant and processing conditions. It is an unplasticized, rigid polyvinyl chloride, inert to most acids, salts, alkalies, and standard pickling and plating solutions.

With AMPCOFLEX, ATLAS has developed specialized fabrication techniques making the advantages of this material available in strong, practical fabricated equipment. Any AMPCOFLEX fabrication requirement can be fulfilled in the ATLAS shops. Moreover, ATLAS is prepared to furnish all accessories . . . nuts, bolts, gaskets, pipe and pipe fittings . . . so that there will be no weak link in your entirely corrosion-proof AMPCOFLEX installation.

For complete data, write for Bulletin 9-1.

... self-supporting, corrosion-proof structures

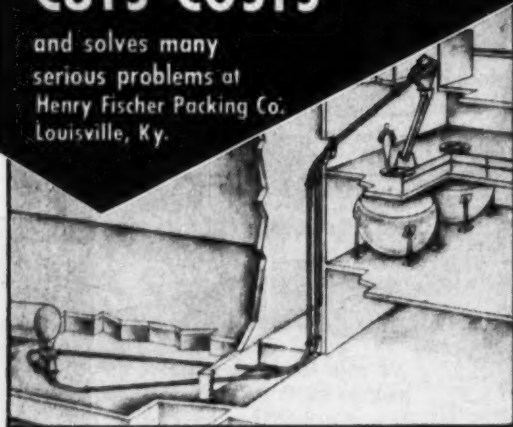
ATLAS MINERAL PRODUCTS CO.
MERTZTOWN, PENNSYLVANIA

FABRICATIONS

HERE'S HELP!

Hapman TUBULAR CONVEYOR CUTS COSTS

and solves many
serious problems at
Henry Fischer Packing Co.
Louisville, Ky.



before . . .

THE HAPMAN WAS INSTALLED, men pushed cart-loads of hashed animal entrails from first floor hasher to elevator—then to third floor cookers. **Result:** Much time lost in clean-up due to spillage on floor . . . large floor space needed to park carts . . . high heat loss when filling cookers.

now . . .

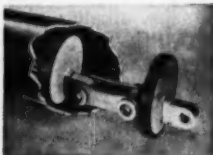
A LIQUID-TIGHT CONVEYOR carries this material from grinder . . . around corners and up three flights . . . discharging directly into one of two cookers. **Result:** Floor space saved, heat loss cut. No spillage, no time lost, *no problem!*

see . . .

HOW HAPMAN CONVEYORS can cut *your* costs—and deliver unique advantages in handling almost any bulk flowable material!

**GET FULL DETAILS—
WRITE FOR BULLETIN CE-254**

Conveyor Cross-Section
shows Flights and Sealed-
Pin Chain.



Hapman CONVEYORS, INC.
DIVISION HAPMAN-DUTTON COMPANY
KALAMAZOO MICHIGAN

THIS MONTH'S

Firms in

New Names

Julius Hyman & Co. Div., Shell Chemical Corp., will now be known as the Agricultural Chemicals Div. The division will continue to market its usual line of insecticides and various agricultural chemicals.

Turck, Hill & Co., Inc. has changed its corporate name to F. B. Turck & Co., Inc. The consulting engineering firm is located at 10 Rockefeller Plaza, New York City.

Research Equipment & Service, Chicago, Midwest representative for the H. E. Ransford Co., Pittsburgh, will now be known as the Packard Instrument Co.

Instrument Engineering Service, Michigan City, Indiana, has changed its corporate name to Thermco Laboratories. The firm manufactures a portable CO₂ analyzer for checking the fuel combustion efficiency of heaters.

New Locations

Shell Chemical Corp. has relocated its Eastern division and New York district at 380 Madison Avenue, New York 17. The former location was 500 Fifth Avenue.

Van D. Clothier, Inc., West coast representative of Wolverine Tube Div., Detroit, Mich., has moved its northern California branch office to 19 South "B" Street, San Mateo, California.

Givaudan-Delawanna, Inc., and associate companies—Givaudan Flavors, Inc., and Sindar Corp.—have moved to larger quarters at 1156 Dalon Drive, N. E., Atlanta.

G. C. Wilson & Co., designer and manufacturer of electronic timers for industry, has moved its

officers and plant from Chatham, N. J., to Huntington, W. Va., to allow for an expansion of facilities.

Gilbert Associates, Inc., Reading, Pa., engineers and consultants, have moved their home office to 607 Washington Street from another part of the City.

The Trane Co., manufacturer of heating and air conditioning equipment, has relocated its Oklahoma City sales office at 819 North Virginia St.

Hercules Powder Co., Inc., has moved its New York (branch) sales office to 380 Madison Avenue, New York 17.

New Lines

H. K. Porter Co., Inc.—To enter the wire drawing field upon the acquisition of The Alloy Metal Wire Co., Prospect Park, Pa., manufacturer of alloy steel wire, rod and strip for the electronic and chemical industries. Porter produces a variety of rubber and electrical equipment, forged steel fittings and hydraulic equipment.

Dow Chemical Co.—Enters a new field as it undertakes the packaging of anti-freezers. In past years, Dow has been a major bulk supplier of glycols for use in permanent type antifreezes.

New Representatives

Magnesium Co. of America, Materials Handling Div., East Chicago, Ind., has named F. E. Bennett Co., Portland, Ore., as sales representative for its magnesium materials handling products.

Insul-Mastic Corp. of America, Pittsburgh, has appointed Robert Lear & Son, Louisville, Ky., as

IS LIQUID CARRY OVER-

LIMITING YOUR PRODUCTION?

AFFECTING PRODUCT PURITY?

CUTTING INTO YOUR PROFITS?

**IF
SO**

GET THE FACTS ON METEX MIST ELIMINATORS!

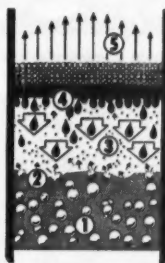
These separators, which are made from layers of knitted wire mesh, literally "filter out" the liquid droplets by impingement and accumulation in depth (see diagram). The liquid is returned by gravity: The gas passes on freed from the unwanted—and often contaminating entrainment.

METEX MIST ELIMINATORS can be easily installed in new or existing vessels. Special housings are not needed, and they have no moving parts to require power and servicing. They will function over an unusually wide range of velocities with a pressure drop generally well under 1" of water. Efficiencies of 99% and over are commonly reported.

While liquid entrainment is an inevitable result of practically any processing operation involving the handling of liquids and gases together, it need no longer be considered as an unavoidable evil. It can be controlled simply, effectively and economically—by a Metex Mist Eliminator, as more and more engineers are finding from experience.



Section of a METEX MIST ELIMINATOR, opened to show construction. Factory cut to fit vessel dimensions and contour, there is no limit to the size in which they can be obtained. They can be made of practically any metal, to combat corrosion.



When a gas is generated in or passes through a liquid (1) it carries with it on leaving the surface (2) droplets of entrained liquid. These droplets are carried upward by the rising gas stream (3). As the gas continually changes direction in passing through the pad, the droplets are impinged on the extensive wire surface. Here the droplets coalesce, forming large drops of liquid which break away (4) from the pad and fall back through the gas stream. The gas (5) passes on, freed from liquid entrainment.

Write TODAY for free catalog giving complete information and engineering data. Or tell us about your SPECIFIC entrainment problem.

METAL TEXTILE CORPORATION
KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

Roselle, New Jersey





Refrigeration

Used in Largest Fertilizer Plant in Latin America

Guanos y Fertilizantes de Mexico S.A., the largest fertilizer plant in Latin America, produces 200 metric tons of ammonia sulphate daily, as well as large quantities of liquid ammonia and 200 metric tons of super phosphate.

Frick refrigeration is used to cool a circulating solution of cuprous ammonium formate, a purifying agent in the synthesis process; and to cool high pressure synthesis ammonia gas to condensing temperature to produce liquid ammonia. In addition, a Frick booster compressor is employed to maintain gas pressures in the system.

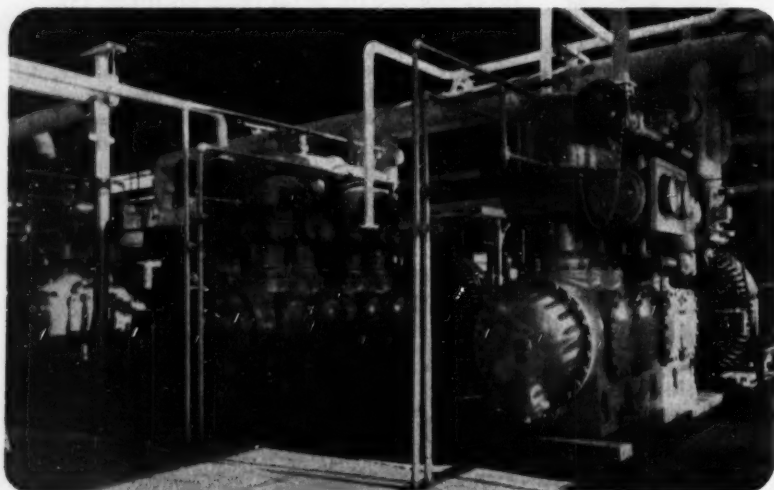
This is but one of the hundreds of different industrial applications of Frick cooling systems now in operation throughout the world.

No matter what type of cooling is required, there's a Frick-engineered system to fill the bill. Write today for literature and quotations.

Dealers in
Principal
Cities Through-
out the World



Two Frick 4-Cylinder 11" x 10" Ammonia Compressors and a 15" x 10" in Service at Plant.



FIRMS . . .

sales agent for its heavy, pressure applied, asphaltic type coatings.

Hewson Co., Inc., Newark, has selected Harris-Hanson Co., St. Louis, as representative for sales, field application and servicing of its line of high voltage d. c. insulation test sets and power supplies.

Hallikainen Instruments, Berkeley, Calif., has designated two new manufacturers' representatives to handle its industrial instruments. The new agents are Louis M. Hachenberg, Wood-Ridge, N. J.; A & A Instrument Co., Chicago.

Fairfield Engineering Co., Marion, Ohio, has named Hank Thurstin Co., Denver, as representative in various Western states, for a variety of coal handling installations for industrial plants.

Damascus Tube Co., Greenville, Pa., manufacturers of stainless steel pipe and tubing, has appointed Industrial Formed Steels, Inc., Warren, Ohio, as its representative in sections of New York, Pennsylvania and Ohio.

Cuno Engineering Corp., Meriden, Conn., manufacturer of industrial filters, has chosen The Jameson Co., St. Louis, as its representative in portions of Illinois, Missouri, Kentucky and Tennessee.

Warner Electric Brake & Clutch Co., Beloit, Wis., has appointed Quinn & McGill Motor Supply Co., Denver, as a distributor for its products in the West.

Rodney Hunt Machine Co., Process Equipment Div., Orange, Mass., has chosen W. C. Davis & Associates, Atlanta, as agent for its Turba-Film evaporator and Luwa spray dryer in the Southeast.

Phillips Rotary Joint & Valve Corp., West New York, N. J., will be represented by Key Co., East St. Louis, Ill. The Illinois

for Pumping SULPHUR



Request BULLETIN V-837

FIG. 19.478

This TABER steam jacketed, Vertical Pump was designed to handle molten sulphur. Note the massive construction. Supporting the suspended pump from channel steel permits the use of an open shaft. This is especially desirable for molten sulphur.

Steam jacketed discharge pipe keeps molten materials from solidifying.

Pump operates efficiently at the relatively slow speed of 1750 r.p.m. (We consider 3600 r.p.m. prohibitive because molten sulphur has no lubricating properties.)

Write us the Head, and gpm you wish to handle together with the depth of your sulphur pit, and we shall send further information, with BULLETIN V-837.

TABER PUMP COMPANY
294 ELM STREET • BUFFALO 3, N. Y.

TABER PUMPS

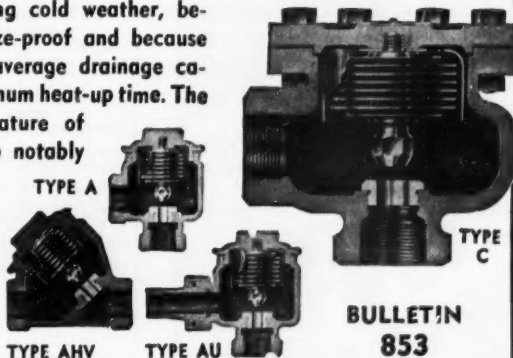
Est. 1859

NICHOLSON MAKES

Freeze-Proof Steam Traps

for Every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Types for every plant use. Size 1/4" to 2"; pressures to 250 lbs.

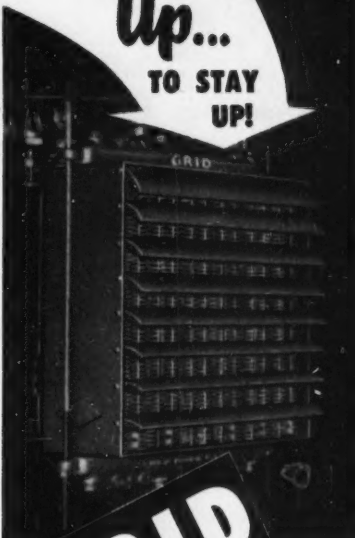


BULLETIN 853

206 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.
TRAPS • VALVES • FLOATS

Put Up... TO STAY UP!



GRID

UNIT HEATERS

*Cast Iron Construction
That Stands Up Against
Corrosive Fumes In
Chemical Plants!*

If your heating installations are not performing satisfactorily investigate GRID Unit Heaters—trouble-free service for over 23 years—a record possible because: GRID, the completely different unit heater, is an all-cast unit with finned heating sections and header tested to withstand steam pressures up to 250 lbs. P.S.I. GRID cast iron construction stands up well against corrosive acid fumes of HCl, Cl₂, etc., plus these features of construction:

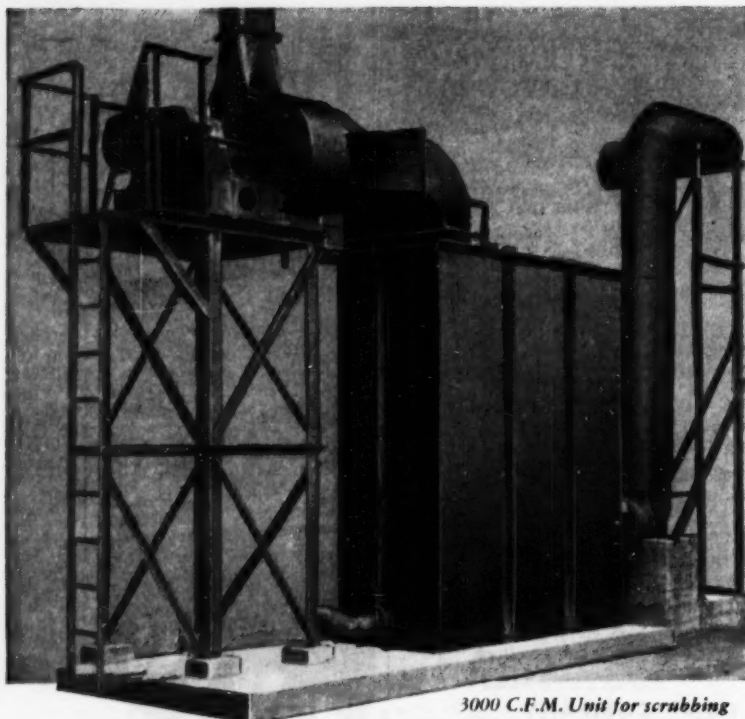
No brazed, soldered, rolled or welded connections between condenser and headers.

All similar metals in contact with steam . . . no electrolytic corrosion which eventually occurs in copper type unit heaters where steam passes from iron pipes into copper cores.

Low outlet temperatures, proper fan sizes and motor speeds, assure delivery of warm comfortable air in ample volume to working level . . . no stratification of warm air at the ceiling to waste your fuel dollars.

* Write for complete catalog . . . also ask about GRID blast coils that are ideal for many uses throughout chemical processing industries (catalog BC-1049).

**D. J. MURRAY
MANUFACTURING CO.**
Manufacturers Since 1883
WAUSAU • WISCONSIN



3000 C.F.M. Unit for scrubbing
corrosive gases from Chemical plant

Another Corrosive Fume Problem Solved By KNIGHT FUME WASHERS

Knight Pyroflex Constructed Fume Washers have solved many difficult gas and fume elimination problems under extremely corrosive conditions. •

The unit above, for example, was job engineered to handle corrosive fumes from a large chemical manufacturing plant. Initially Knight engineers considered all service factors involved including water consumption and fan power. Construction materials were selected according to corrosive factors involved. The result was a complete functional unit job-engineered to solve a specific problem in corrosive fume elimination. Although individually engineered Knight Fume Washers are relatively low in cost and economical in operation.

TYPICAL APPLICATIONS

- Absorption of HCl fumes
- Suppression of oil and acid mists
- Removal of pickling tank vapors
- Removal of dust from exhaust gas
- Removal of chlorine fumes
- Absorption of hydrofluoric acid fumes
- Cooling hot acid gases for processing
- Many other types of service



Write for Bulletin No. 9 Fume Washers.

Maurice A. Knight

Acid and Alkali-proof Chemical Equipment

Kelly Ave., Akron 6, Ohio

FIRMS . . .

agent is also a manufacturer of fittings and flanges for alloy steel industrial piping systems.

Atlas Mineral Products Co., Mertztown, Pa., has selected O. A. DeCelle & Associates, Chicago, as Midwest representative for its water and sewer jointing materials.

Ampco Metal, Inc., Milwaukee, has selected Western Oxygen, Inc., Seattle, and Steel Products & Mfg. Co., Huntington, W. Va., to represent its Ampco-Trode and Phos-Trode welding products in their respective areas.

Godfrey L. Cabot, Inc., (White Pigments Div.), Boston, chemical manufacturing firm, has appointed B. F. Wagner & Co., Pasadena, as representative of its wollastonite products to the ceramics industry in the California area.

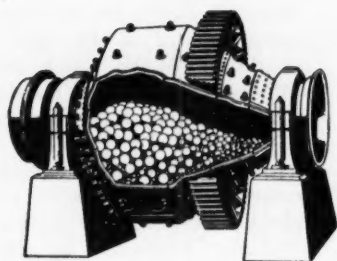
Universal Detergents, Inc., Long Beach, Calif., has named Philipp Bros. Chemicals, Inc., as Eastern distributors in the agricultural field for its line of surfactants used in fertilizer formulating.

New Companies

Gene Rose Co., Inc., Chicago—To specialize in the production of pressurized dispensers. In addition, the firm will offer confidential product development work as well as complete packaging services. The firm is an affiliate of The Scientific Oil Compounding Co.

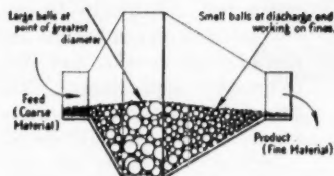
Cascade Natural Gas Corp., Seattle—The result of the merger of five Washington state gas companies; Bellingham Gas Co., Bremerton Gas Co., Wenatchee Gas Co., Northwest Cities Gas Co., Consolidated Gas Co.

Westvaco Chlor-Alkali Div. and Westvaco Mineral Products Div.—Two new divisions for the Food Machinery & Chemical Corp. were created out of the previous single unit—Westvaco



for
BALL SEGREGATION . . .

**Hardinge
Conical Mills**



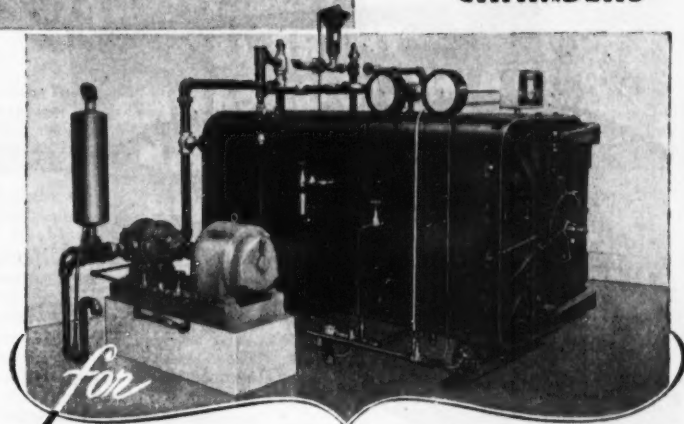
The conical shape of the Hardinge Mill causes a rapid circulation and classifying action within the drum, which increases the capacity for power expended over other types. The range of grinding is large, due to the segregation of the sizes within the mill. The conical shape insures extreme rigidity and simplicity. Mechanical troubles are practically unknown. Sizes range from 2 feet to 10 feet with capacities from a few pounds per hour to 100 tons per hour. Bulletin 17-B-11 gives full details of dry grinding applications. Bulletin AH-389-11, wet grinding.

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COMPANY, INCORPORATED

VORE, PENNSYLVANIA • 345 Arch St. • Main Office and Works
New York • London • Chicago • Milwaukee • Cincinnati • San Francisco • San Jose

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**VACUUM-PRESSURE
CHAMBERS**



Steam Sterilization • Automatically controlled temperatures and exposure periods • Corrosion resistant metal chambers • Quick opening and closing "safety stop" door.

Carboxide Gas Sterilization • Positive sterilization of heat- and moisture-sensitive products at low temperatures: Plastic Containers • Packaged Pharmaceuticals • Surgical Dressings • Packaged Food Products • Rubber Goods.

Moisture Impregnation • Products may be increased in moisture content by economical constant temperature-constant humidity process • Temperatures may be controlled to achieve destruction of insects, larvae and eggs.

Pasteurization • Temperatures ranging from 150° to 250° F maintained uniformly throughout chamber. Settings easily changed to accommodate various products.

Fumigation • Vacuum-pressure chambers for use with carboxide, methyl bromide or other gases for fast-high production fumigation.

• Specialists and Consultants in Sterilization, Fumigation and Sanitation for the Pharmaceutical, Chemical and Food Processing Industries since 1894

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AMERICAN STERILIZER COMPANY • Erie, Pennsylvania

**FOR YOUR STAINLESS STEEL
FITTINGS AND FASTENERS**
IT'S ALLMETAL FOR QUALITY AND DELIVERY

Allmetal's fasteners and fittings are stocked in types 304 and 316.
Specials to order. All made right by Allmetal.

ALLMETAL, Specialists
in Stainless. Produce
Stainless Products
Exclusively.



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CATALOG PG



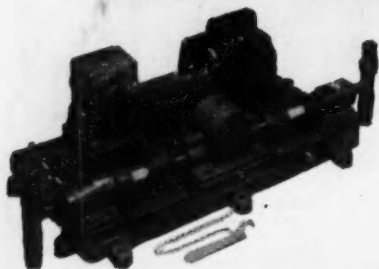
MANUFACTURERS SINCE 1929

ALLMETAL
SCREW PRODUCTS COMPANY, INC.

821 STEWART AVE. GARDEN CITY, N. Y.

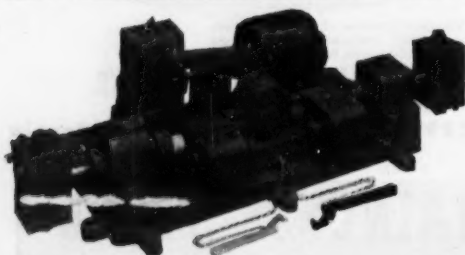
**If you meter or proportion
small volume flows...**

**THERE IS
A HILLS-McCANNNA
"U" TYPE PUMP
TO DO THE JOB**



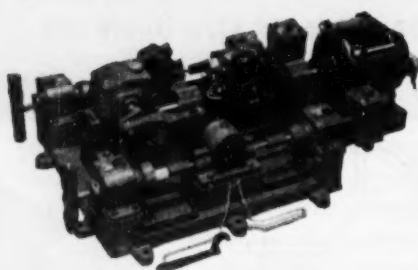
**STANDARD
1, 2, 3 or 4 FEED
UNITS**

Standard "U" Pumps are available in maximum capacities from 0.10 to 24.0 gal. per hr. per feed. Operating pressures from 125 to 5000 psi.



**JACKETED
UNITS**

For handling materials that require heat or refrigeration, "U" Pumps can be supplied with either or both jacketed liquid ends and check valves.



**VARIABLE
SPEED UNITS**

"U" Pumps can be furnished with a variable speed drive which permits varying capacity remotely or automatically when combined with the proper auxiliary equipment.

Write for Catalog:

Catalog UP-52R gives full data on all sizes and types of Hills-McCanna "U" Type Pumps. Write for a copy, today. Hills-McCanna Co., 2341 W. Nelson St., Chicago 18, Ill.



HILLS-McCANNNA

metering and proportioning pumps

Also Manufacturers of:

**SAUNDERS TYPE DIAPHRAGM VALVES
FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS**

FIRMS . . .

Chemical Div. The former division will handle the manufactures produced at the firm's Charleston, W. Va., plant; the latter will take charge of barium and magnesium chemicals.

Percy L. Julian Research Laboratories, Chicago—To conduct research in steroids and pharmaceuticals. Organized by the former director of research for the food division of Glidden Co., Chicago.

Stecker Chemicals Inc., Ridge-wood, N. J.—To specialize in the research, development and sale of chemicals and intermediates to the paper and pharmaceutical industries.


Columbia International Corp., Clark (Rahway), N. J.—To offer trichlorethylene and other chlorinated solvents, a full line of metal-finishing equipment and various industrial chemicals.

Process Plants Service, Inc., Elizabeth, N. J.—To serve the ceramics, petroleum refining pulp and paper, fertilizer and plastics industries with process equipment and plant appraisal services.

Combustion and Explosives Research Inc., Pittsburgh—To conduct research on combustion and explosion phenomena and their technical applications. The firm will offer consulting services in various chemical fields—particularly: chemical and engineering thermodynamics, heat transfer and oxidation of fuels.

Thermo Electric (Canada) Ltd., Brampton, Ont.—To manufacture and sell industrial temperature-measuring equipment. The firm is a subsidiary of Thermo Electric Co., Inc., Saddle River, N. J.

Ferro Powdered Metals, Inc. Salem, Ind.—To manufacture high-precision powdered metal machine parts for agricultural equipment. The firm is a wholly-owned subsidiary of Ferro Corp.,



**"THIS LUBRICANT
EXTENDED
BEARING LIFE
50%"**

—says REPUBLIC AVIATION CORP.
Makers of the famous F-84E THUNDERJET

"Under actual tests, LUBRIPLATE extended bearing life fifty per cent or better as compared to other lubricants. It was also found that, during test, LUBRIPLATE increased efficiency of machines twenty per cent by reducing friction loss. Republic has been using LUBRIPLATE successfully for the past eight years."

**REGARDLESS OF THE SIZE AND
TYPE OF YOUR MACHINERY,
LUBRIPLATE GREASE AND
FLUID TYPE LUBRICANTS WILL
IMPROVE ITS OPERATION AND
REDUCE MAINTENANCE COSTS.**

LUBRIPLATE is available in grease and fluid densities for every purpose... LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.



For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.



New Type Eppenbach COLLOID MILL

Featuring

Large Tangential Outlet which prevents back pressure and allows increased output capacity. Both Rotor & Stator are interchangeable. Stellite rings and stones—facilitating replacement when required.

Sanitary fittings throughout. Illustration shows large production Mill Model QV-11 with 15 H.P. motor.

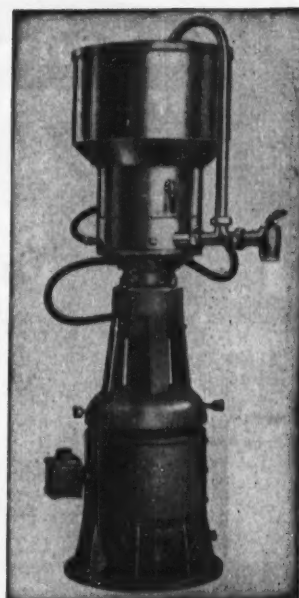
Eppenbach Colloid Mills operate at speeds approaching the theoretical minimum required for true wet micro grinding—shaft speeds up to 10,000 r.p.m. depending on size and type of mill.

These Mills assure uniform grind through advanced engineering features including (1) Improved ball bearings which center the shaft and minimize lateral whip and (2) Invar shafting with zero coefficient of heat expansion.

All Mills can be made with pressure feeds and jacketed hoppers.

Consult our Sales Department with your technical problems.

Write for literature describing Eppenbach equipment—now manufactured and sold by:



Direct-drive model shown operates at 3500 RPM. Higher speeds can be furnished. Colloid Mills made in all sizes from 1/4 H.P. model laboratory size to 50 H.P. model.

ADMIRAL TOOL & DIE CO., INC.

45-10 VERNON BOULEVARD
LONG ISLAND CITY, 1,

N. Y.

**3 PUMPS
IN ONE**

7,500, 15,000 or 30,000 psi working pressure made possible by the interchange of piston and cylinder assemblies in the same pump frame

MICRO-FLEX CHEMICAL PROPORTIONING PUMPS

Simplex and Duplex Styles



PATENT
APPLIED FOR

CHECK THESE IMPORTANT ADVANTAGES

1. All liquid in the cylinder is displaced at every stroke.
2. Variable delivery—stroke readily adjustable while pump is running. Locking nut maintains stroke adjustment.
3. Stroke adjustment indicating scale is stationary and legible while pump is running.
4. Stainless steel piston and cylinder assemblies for 7,500, 15,000, and 30,000 psi working pressures are interchangeable in the same pump frame. Simplex and duplex styles.
5. Piston reciprocated by positive mechanical linkage to crank arm—does not rely on return spring.
6. Check valves removed easily for cleaning or replacement.

WRITE FOR BULLETIN 4061-A



Superpressure Division
AMERICAN INSTRUMENT CO., INC.
Silver Spring, Maryland • In Metropolitan Washington, D. C.

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SUPERPRESSURE
PRODUCTS**

REACTION VESSELS
VALVES • FITTINGS
TUBING • PIPES
COMPRESSORS
INSTRUMENTS
DEAD-WEIGHT GAGES
PILOT PLANTS

DESCRIBED IN
CAT. 406-A

**pumping for
processing**

**pumping for
air conditioning**



multi-duty **SERVICE with DEMING PUMPS**

Pumping well water at a temperature of 52° for air conditioning and then to a central reservoir for other factory uses is the multi-duty service of five Deming Vertical Turbine Pumps at a Remington-Rand plant in Elmira, N. Y. Installed in 1942, three of the pumps operate 9 hours a day and two pumps run continuously. Since 1942, only one of the five pumps has been pulled for maintenance.



Send for **BULLETIN NO. 4700-51**

Important facts about Deming Vertical Turbine
Pumps are in this illustrated bulletin.

THE DEMING COMPANY

525 Broadway • Salem, Ohio, U. S. A.

Specify- **DEMING
PUMPS**

FIRMS . . .

Cleveland — manufacturer of products for the ceramics, porcelain and chemical industries.

Bradley Container Corp., Maynard, Mass.—To manufacture and market plastic tubes and bottles made by a newly developed European process for which the company has exclusive U. S. and Canadian patent rights.

Borolite Corp., Niagara Falls, N. Y.—To pursue research and development of various metal borides for high temperature applications by government and industry. Firth Sterling Inc., Pittsburgh; American Electro Metal Corp., Yonkers; and Carborundum Co., Niagara Falls, have united forces to expand the facilities of the new firm.

Western Filling Corp., Los Angeles —A new aerosol packaging firm. Western offers complete aerosol refrigerated and pressurized packaging, as well as laboratory facilities.

New Facilities

Monsanto Chemical Co., St. Louis —Complete realignment of the firm's divisions and departments to provide for more efficient coordination of operations. The new structure involves the organization of a Research & Engineering Div. and an Inorganic Chemicals Div. (previously the Phosphate Div.)

Foote Bros. Gear & Machine Corp., Chicago— A Southgate (Los Angeles) sales and service branch office to better accommodate west coast manufacturers. The firm specializes in speed reducers, for heavy applications, and in a variety of commercial gearing.

Foxboro Co., Foxboro, Mass.—An Amarillo, Texas, branch office for this manufacturer of industrial instruments for the measurement and control of process variables. Expanded industrial



One of many filter presses for clarifying and for recovery, washing and partial drying of filter cake in fine chemical manufacture.

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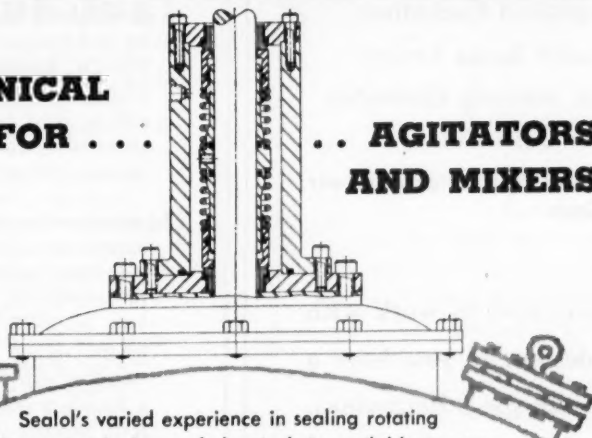
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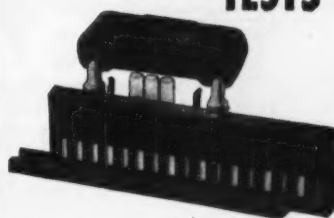
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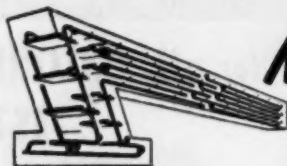


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FIRMS . . .

activity in the region, particularly in the oil and gas, chemical and petrochemical industries made the creation of the new branch a necessity.

General Ceramics & Steatite Corp., Keasbey, N. J.—An operating affiliation with Techno Ceramica, S. A., Sao Paulo, Brazil, has been established. The U.S. firm will supply technical knowledge for the manufacture of high frequency insulators at the Brazilian plant.

General Chemical Div., Allied Chemical & Dye Corp.—Enlargement of the sulfuric acid production capacity of its Detroit Works in River Rouge, Mich. The new unit will double the plant's production capacity in responding to the needs of the chemical and fertilizer manufacturers in the Detroit industrial area.

Gladding, McBean & Co.—Purchased land, buildings, machinery and equipment of Anegeleto Tile Co., Redondo Beach, Calif. The modern, four-year-old plant will be used for production of glazed tile—to be marketed under the name Hermosa Clay Tile.

Mathieson Chemical Corp.—New outlets for chemical, drug and anti-freeze preparations through the acquisition of Puritan Co., Inc., Rochester, N. Y., and its wholly owned subsidiary—Genesee Research Corp. Puritan is a leading manufacturer and contract packager of specialty chemicals.

Emjay Maintenance Engineers, Rutherford, N. J.—Branch office in Philadelphia has been opened by the firm to comply with an increased demand in that area for Emjay's specialized maintenance services and products.

Engineering Corp. of America, Westfield, N. J.—A chemical engineering process design division which will offer consulting services to chemical plants in



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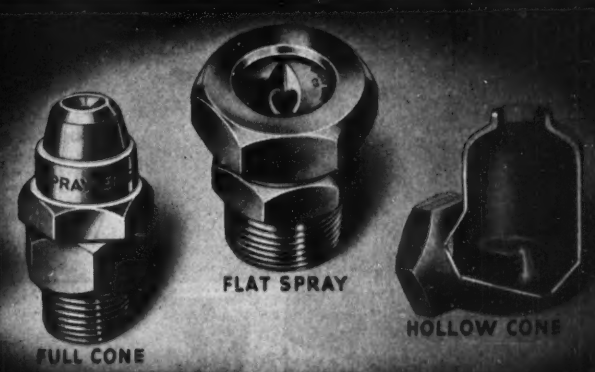
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CHEMICAL ENGINEERING—February 1954



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Our organization welcomes inquiries pertaining to our chemicals. All correspondence is strictly confidential.

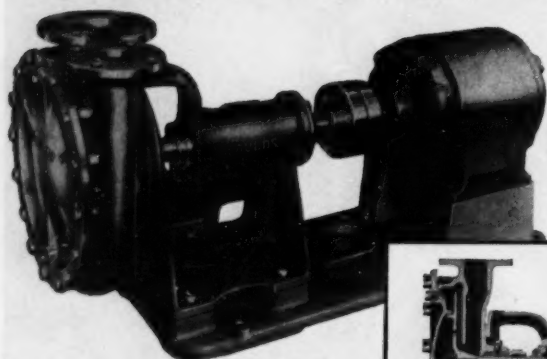
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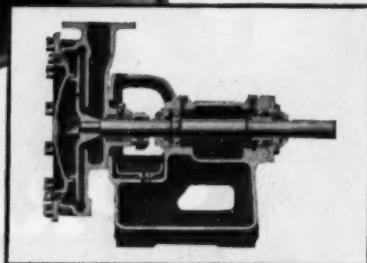
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GOULDS Fig. 3705
Removal of casing cover permits interior inspection and cleaning. Capacities to 600 G.P.M. Heads to 160 ft.



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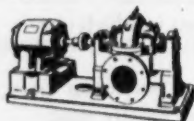
Other GOULDS for General Industrial Use



GOULDS Fig. 3169
Single stage centrifugals for general processing purposes. Capacities to 1100 G.P.M. Heads to 180 ft.



GOULDS Fig. 3047
Vertical sump pump with nonclogging impeller for water containing large solids or fibrous materials.



GOULDS Fig. 3405
Highly efficient, compact new pump for all general liquid handling applications. 19 sizes. Capacities from 200 G.P.M. to 6400 G.P.M. Heads up to 260 ft.

Here's how an alert plant engineer cut pumping costs by 75%: When the pumps he was using to handle a highly corrosive liquid wore out, he replaced them with Goulds Centrifugal Chemical Pumps, *costing only one-fourth as much*. The Goulds pumps have already lasted *twice as long* . . . and they're still going strong.

Sturdy Construction Means Long Wear

The entire fluid end of this pump is made of stainless steel and mounted on a cast iron support. Other material and alloys can be supplied for wetted parts. With the stuffing box on the suction side, pressure on it is limited to the suction head only, assuring long packing life and freedom from excess leakage. Interchangeable parts assure reduced inventories. For complete information, contact your nearby Goulds representative or write for Bulletin 725.3.



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PUMPS INC.

**Seneca Falls
New York**

FIRMS . . .

connection with the development and design of process units and equipment.

First National Petroleum Corp.—Purchase of a \$250,000 refinery at Jensen, Utah, from the Utah Cooperative association. The petroleum firm plans to double the refinery capacity to 3,000 b/d. A \$1,250,000 cracking unit will also be constructed.

Pennsylvania Industrial Chemical Corp.—A merger with the Pennsylvania Falk Chemical Co. will provide for an expansion of facilities for the firm. Offices in New York's News Bldg. (42nd Street) and in Chicago have been opened as a result of extensive sales operations.

J. H. DeLamar & Son, Inc., Chicago—New offices, plant and warehouse have been opened by the firm on North Kedzie Avenue, Chicago.

A. O. Smith Corp., Milwaukee—Purchase of Glascote Products, Inc., Cleveland, manufacturer of glass coated equipment for the chemical processing industries. Glascote will complement the activities of Smith's Process Equipment Div. which produces pressure vessels and heat exchangers.

American Dyewood Co., United Dye & Chemical Corp.—Expansion of its operations in the cement colors and allied fields, for this major manufacturer of dyes and pigments.

American Metal Products Co., Detroit, Mich.—Completion of a merger, on a stock basis, with Tube Reducing Corp., Wallington, N. J. American Metal—the surviving corporation—will operate both businesses with separate corporate identities.

Kaiser Gypsum Co.—Plans to construct a \$4 million wallboard plant at Seattle, Wash., to provide for the firm's expansion of activities.

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The patented SCHNEIBLE vari-vane construction makes MULTI-WASH the only wet method dust collector that washes dust, fumes and odors out of the air (not once) but many times. As air passes through the unit, maximum scrubbing action and the highest percentage of material removal is assured.

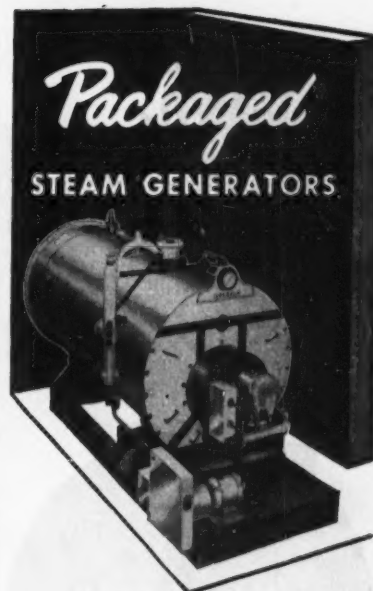
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THE ROAD TO ABUNDANCE

A research chemist and a noted author show in this challenging book how chemical research and manufacture are the keys to bringing the world cheaper and more abundant food and material supplies. A clear picture of what chemistry can do both in the laboratory and in big production. Covers chemistry's achievements to date, the use of synthetics in place of natural products, and the steps in satisfying mineral needs from the "dilute abundance" in the air, ocean, and the earth's crust. By J. Rosin and M. Eastman. 166 pp., \$3.50

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Now you can find in a single handbook the facts that literally do show how to run a plant today—any industrial plant—efficiently and economically. Answers questions in the economic, mechanical, and power operation

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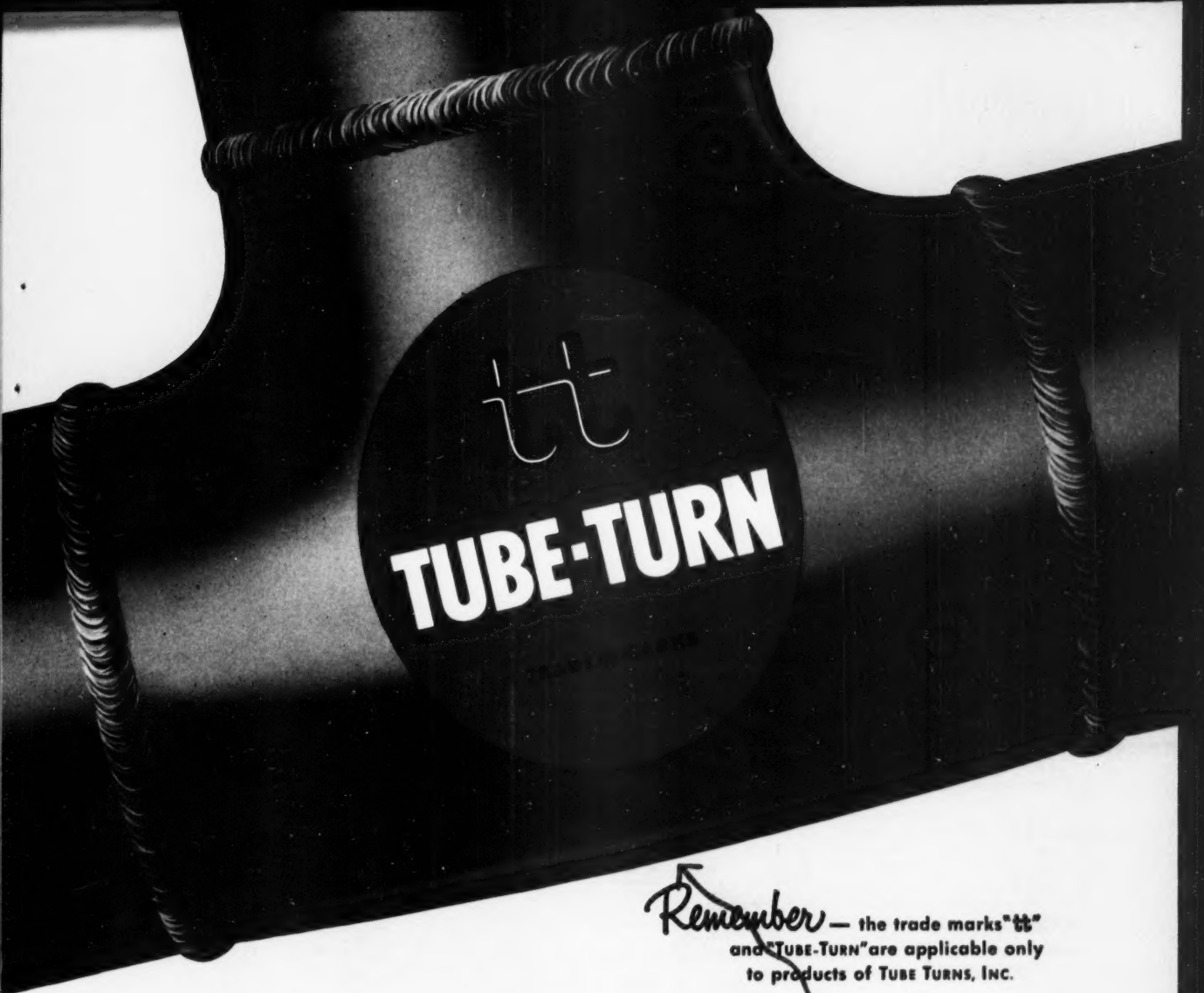


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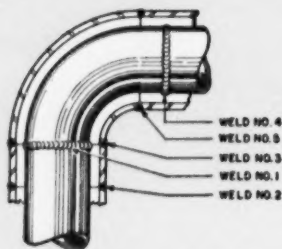


TUBE TURNS' ENGINEERING SERVICE

develops new method of fabricating jacketed fittings

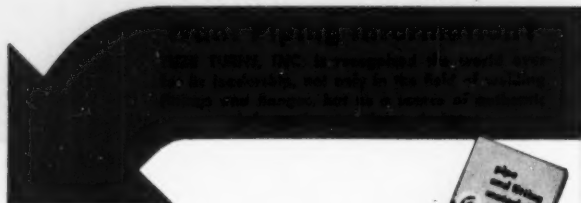
FABRICATION TIME AND COST can be reduced with this method of using welding fittings for directional changes in jacketed piping systems. The jacketed fitting combination consists of long and short radius TUBE-TURN Welding Elbows, with center-line radii closely matching. A tangent on one end of the inside elbow (see cut) extends beyond the corresponding end of the outside elbow. On the other end a short length of pipe is attached to simplify installation.

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Welding sequence for elbow of jacketed system.

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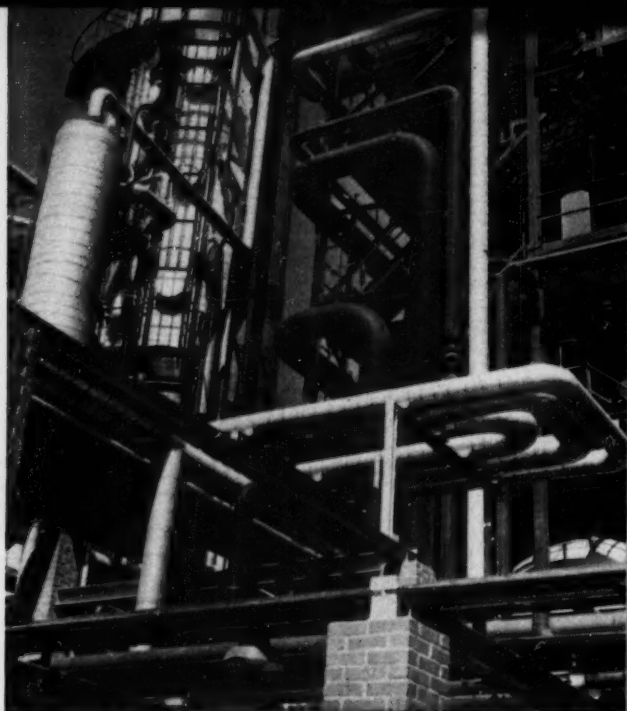
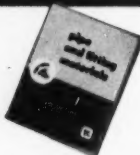
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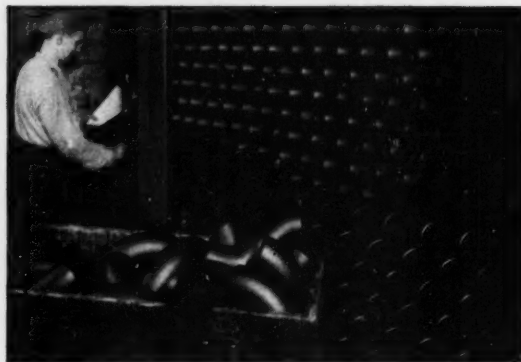
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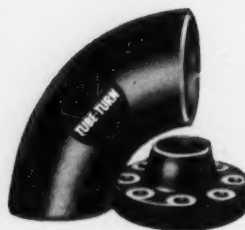
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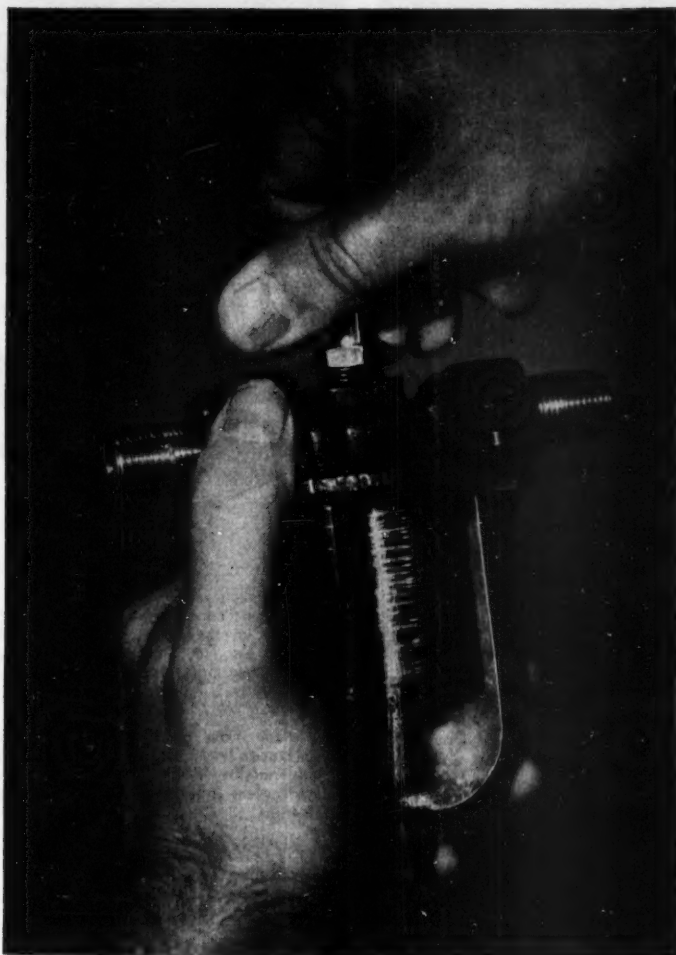
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A.3.8



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All-metal AUTO-KLEAN assures
non-stop fluid filtration

You never need to stop a run to clean the filter when you use a Cuno AUTO-KLEAN. Just an occasional rotation of the handle does the cleaning job—while fluid is flowing through the strainer.

Thus, no loss of production, no chance of contaminating your product by exposure while cleaning or replacing an element.

AUTO-KLEAN's all-metal construction makes it ideal for the chemical industry. Resistant to high temperatures, AUTO-KLEAN's can also be supplied in metals that resist the corrosive action of most chemicals and solutions. And it's easy to sterilize AUTO-KLEAN with solvents or steam.

Of course, AUTO-KLEAN makes the recovery of expensive solids a simple operation.

The compact AUTO-KLEAN will give you full-flow filtration in space which would limit ordinary filters to by-pass service. And AUTO-KLEAN's low pressure drop permits this full-flow service on gravity, low pressure, or suction lines—with no loss in operating efficiency.

The fixed-space metal discs in this modern strainer positively remove all solids larger than the specified disc spacing—from .0035" (170 mesh) up to .062" (12 mesh).

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A.3.12

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for (fluid)

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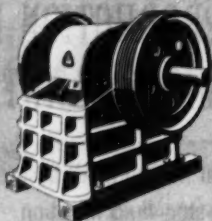
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DENVER EQUIPMENT



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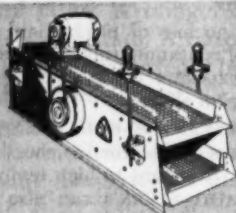


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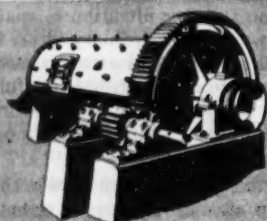


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Features: Cast steel heads, cut tooth gears, protected trunnion bearings and manganese steel liners.

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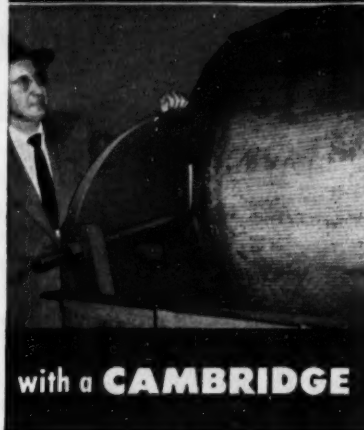
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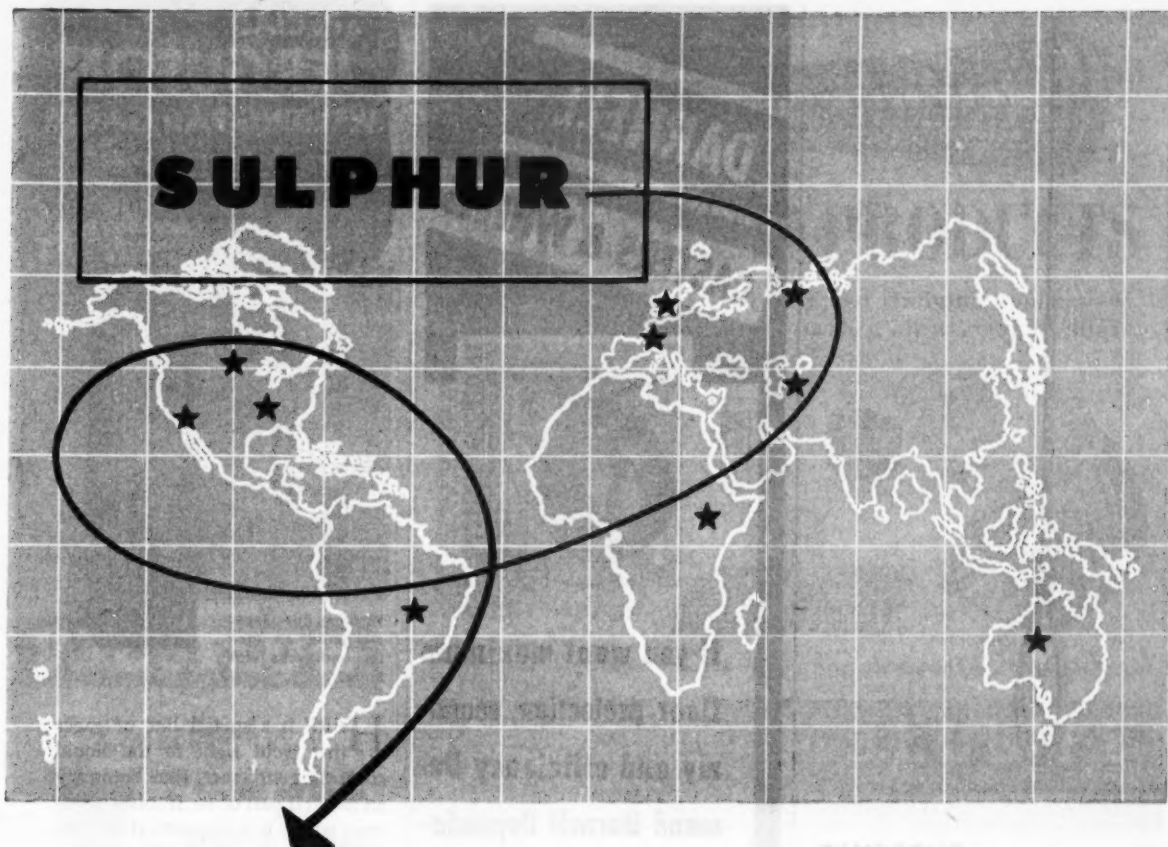
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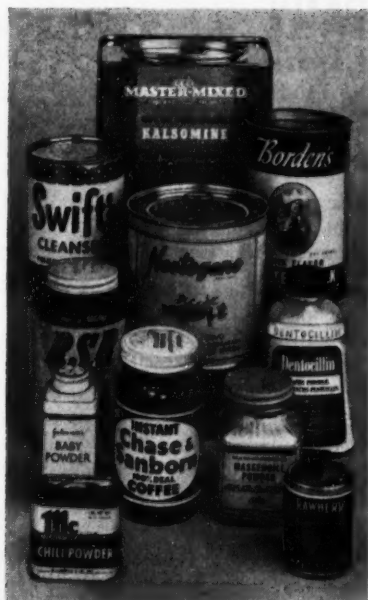
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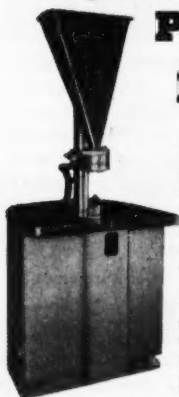
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Pneumatic is the one manufacturer in a position to furnish machines for making up complete production lines. Units are available for air cleaning, powder and liquid filling, capping and labeling a wide range of bottles, cans or jars.

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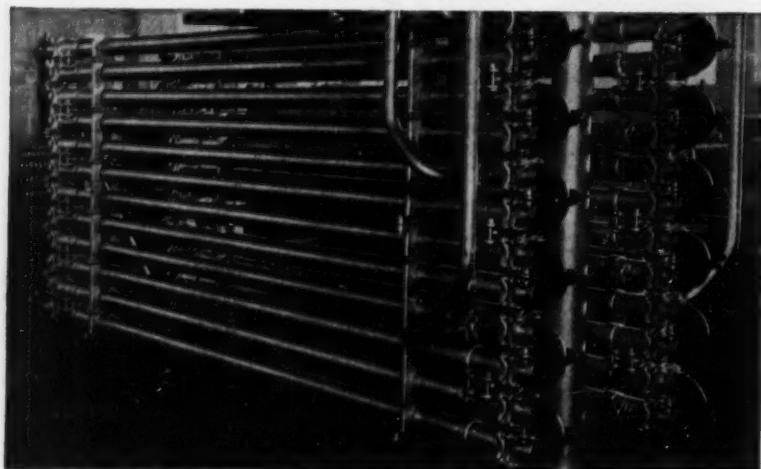
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Ammonia-type Beer Chiller—outer 3" pipes of steel; inner 2" Duplex Tubing with steel over copper. Beer is circulated through copper circuit. Courtesy The Vilter Manufacturing Co., Milwaukee, Wis.

Copper and its Alloys Increase Service Life of Refrigeration Systems

Mechanical refrigeration has grown very rapidly and has deeply penetrated industrial, processing, chemical, refining and domestic fields.

Since refrigeration systems involve many miles of tubing which must handle corrosive liquids, gases, or cooling waters, the selection of tube alloys capable of standing up under severe service conditions is one of the most fundamental problems confronting the engineer. In this field copper-base alloys are predominantly used because they have proven very satisfactory.

Freon and Methyl Chloride Refrigerants

Where refrigerants such as Freon or methyl chloride are used, Copper, Red Brass, Admiralty, Aluminum Brass, Aluminum Bronze and the Cupro Nickel alloys are corrosion resistant and give long life. The selection of the proper alloy depends upon the cooling water, brine, or product.

Ammonia Refrigeration

The good corrosion resistance of steels to ammonia, both gaseous and liquid, explains their wide use in the

construction of equipment handling ammonia. However, steel tubes and pipes are subject to corrosion from brine, sea water or fresh water. This shortcoming can easily be overcome through the use of Duplex Tubing, consisting of copper or copper-base alloy to the water side and steel to the ammonia side. This combination is finding wide application not only for ammonia refrigeration, but also for equipment producing ammonia and its compounds.

The most popular combinations are low carbon steel with Copper, Admiralty, or Red Brass for handling fresh water from rivers, lakes, ponds, and wells. Where sea water is used for cooling purposes, Cupro Nickel, Duralonze IV (arsenical aluminum bronze), Aluminum Brass, and Admiralty are preferred because of their greater corrosion resistance.

Corrosion by Brine

In general, copper and its alloys stand up very satisfactorily handling cooling brines. Where general or localized corrosion occurs, it is usually due to the presence of other substances in

the brine. For example, ammonia contamination may lead to corrosion cracking of stressed yellow brasses.

Corrosive Atmospheres

Where air is being cooled, the moisture in the air is precipitated on the cool surface of the tubes. Such condensate may absorb corrosive gases and salts which are destructive to ferrous metals. Copper and its alloys generally withstand this type of corrosion very satisfactorily.

Where air instead of water is cooling the refrigerant, copper and its alloys give excellent service.

Circulating Fresh Water

For fresh water, Copper is very widely used. Admiralty and Red Brass are also in common use, the Admiralty being preferred where sulfides are present in the cooling water.

Circulating Sea Water

For sea water at velocities of 5 to 6 ft. per second, Arsenical Admiralty stands up well. Where the velocities exceed this speed, impingement corrosion may be encountered in Admiralty tubing. Under these conditions Aluminum Brass, Cupro Nickel or Duralonze IV should be used because of their superior resistance to impingement.

Product Corrosion

For handling beverages, chemicals, liquids, or gases, the selection of the most suitable metal depends upon the nature of the product handled. For many applications, copper and its alloys are very satisfactory. For special cases involving the handling of liquids or gases corrosive to copper, or where product contamination by traces of copper is undesirable, Duplex Tubing consisting of Aluminum, Low Carbon Steel, Stainless, etc., combined with Copper and its alloys often give excellent service.

Laboratory Service

Bridgeport corrosion metallurgists have been helpful in recommending Duplex Tubing combinations which have led to improved operating efficiencies. Not only has tube life been greatly extended but lower maintenance has resulted. Contact your nearest Bridgeport office for help on your metal problems and for your tube requirements. (1338)

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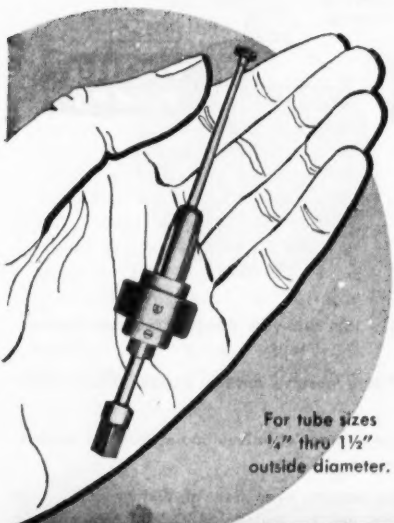
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Fig. 645

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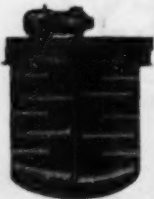
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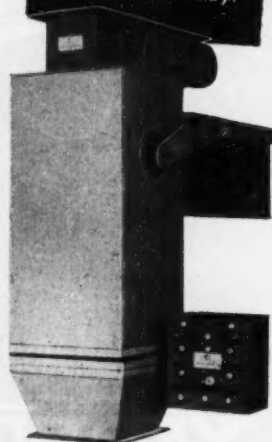
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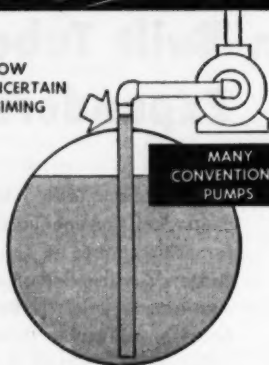
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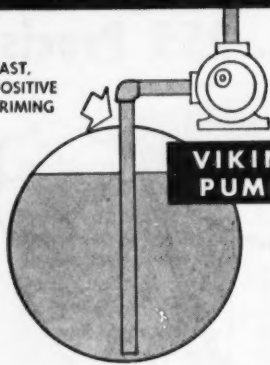
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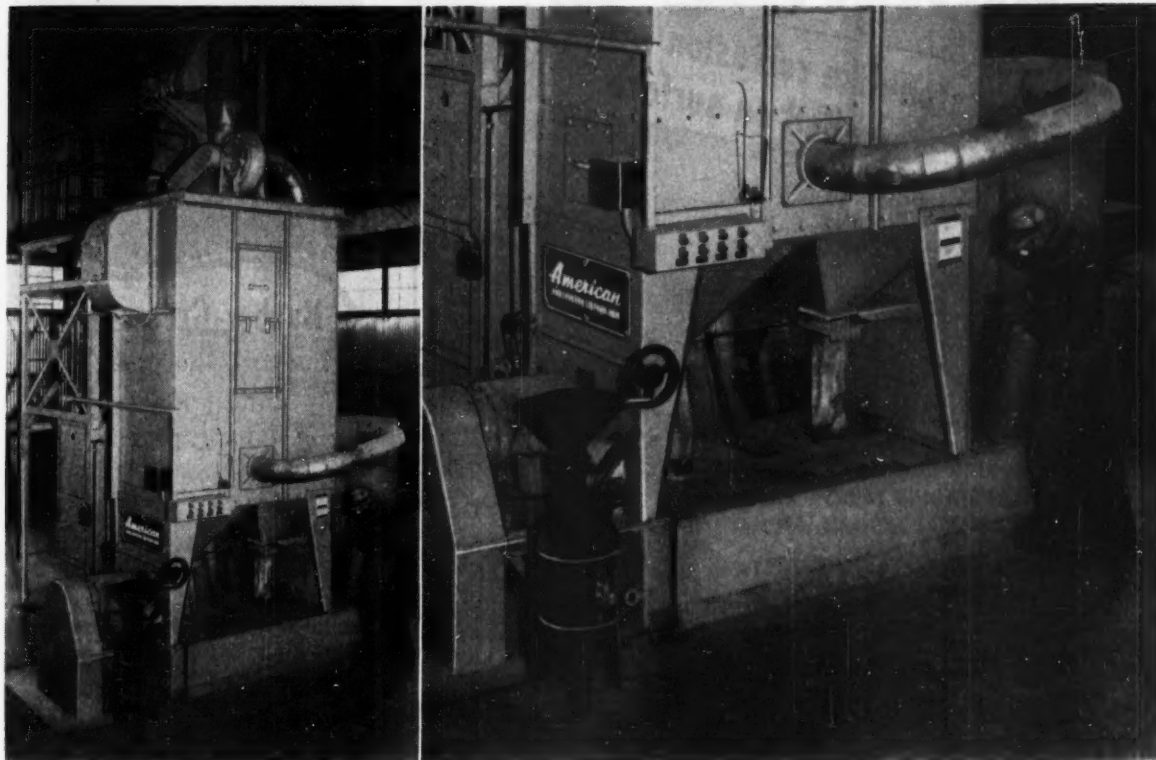


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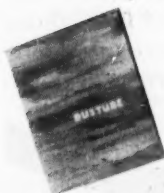
proves economy and dependability of Dustube Collectors

Almost everyone recognizes a repeat user as an indication of satisfactory service. Then, a repeat user—46 times—must be an indication of outstanding performance. The California Spray Chemical Corp., one of the leading manufacturers of insecticides, has adopted Dustube Collectors as standard equipment in portable insecticide dust plants all over the country. They have standardized on Dustubes because of their

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The story is the same time after time . . . Dustube Collectors control dust more effectively, at lower cost. They remove dust with virtually 100% efficiency to make men and machines more efficient.

In spite of this high efficiency, Dustube Collectors cost less initially and are unusually economical to operate and maintain. Maintenance is limited to occasional tube inspection and replacement. Power costs are less than for other methods. As a result, Dustube Collectors give you more positive dust control for a lower capital outlay. In many cases, savings in operating costs quickly repay the cost of the installation.



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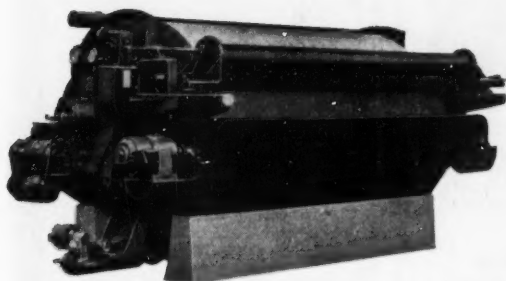
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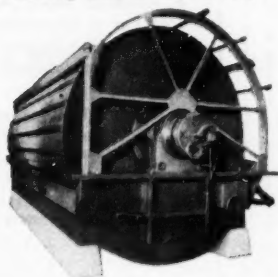
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**Each the Nemesis of Pulps Forming
Thin, Sticky, Flow-Retarding Cakes**



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• The Oliver Panel Filter in contrast to the Precoat Filter doesn't use a precoat. Nor is there any wire winding to hold the cloth on the drum. An ingenious discharge mechanism picks the thin cake off the cloth leaving it clean and ready for further cake deposition. The cloth is in a relatively small piece and is held in place by caulking into recesses between sections.

**Precoat
FILTER**
**Panel
FILTER**

WHY two distinctly different filters for handling pulp forming one class of filter cake? Another question answers that one: "What do you want to do with the cake? Keep it or throw it away?"

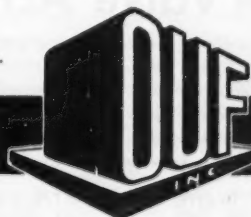
The Precoat Filter makes use of a pre-formed layer or 'precoat' of filter aid which, as it is removed with the cake, mixes with it. Usually such cakes are discarded, although it is often possible to separate the solids from the precoat by a suitable solvent.

The Panel Filter does not use a precoat or pre-formed layer of filter aids. Thus it discharges the solids uncontaminated in any way. It, too, handles easily those thin, sticky, flow-retarding cakes. It is usually recommended when the cake is valuable or is to be processed further. We call these two filters to your attention in case you wish to obtain the advantages of continuous and automatic filtration of a pulp that for one reason or another produces an extremely thin cake.

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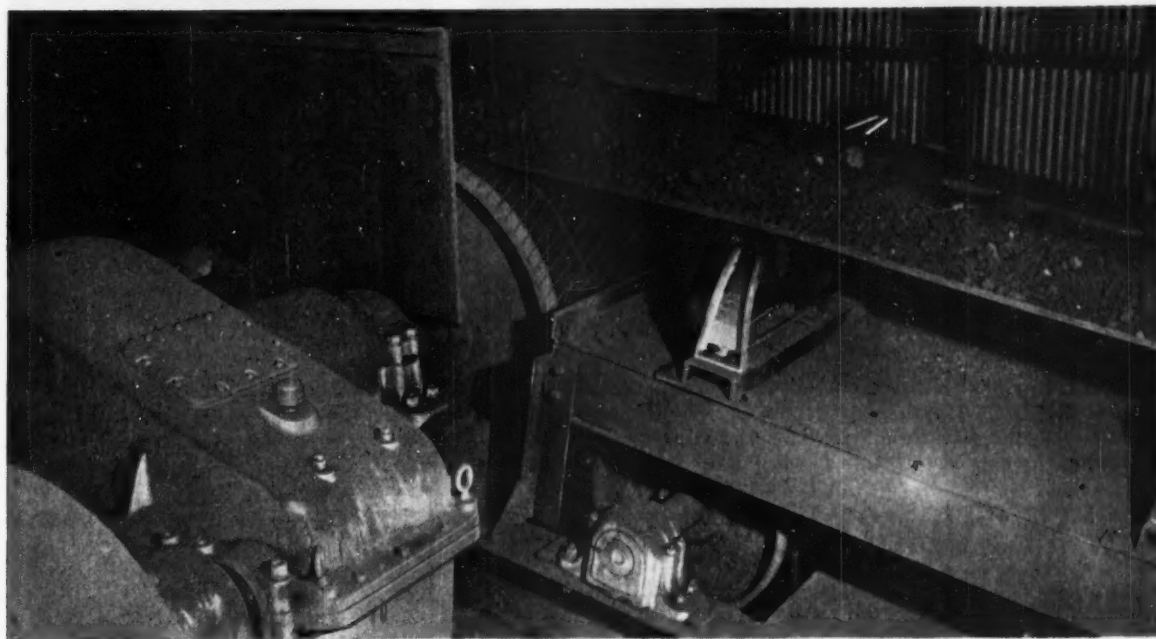
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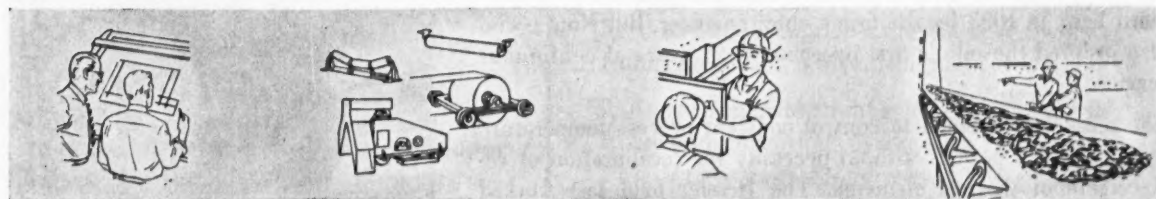
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Engineered for long-life, this Link-Belt 48-inch wide, inclined belt conveyor employs Series 200 troughing idlers, welded steel pulleys (both plain and rubber lagged), roller bearings and an enclosed gear drive.

LINK-BELT offers you the "total engineering" so necessary for top efficiency



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Next time you're in the market for one belt conveyor or a complete system, call a conveying expert in the Link-Belt office near you. It's his job to help you get the best in belt conveying at the lowest possible overall cost.

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LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

13, 500-E



CHIEF ENGINEER WILLIAM NOTE inspects the original Leslie Temperature Pilot taken from heater for its first overhaul. Leslie Representatives **Frank Riggio** (left) and **Bob Gentner** (right) look on.



DEWITT O. HESSLER, Laundry's President, joins Chief Note in examination of the original Leslie Pilot before reinstallation.

HOW SHOULD A 21-YEAR-OLD BEHAVE?

Temperature Pilot leads flawless life for 21 years prior to its recent, initial overhaul

A 21-year-old Leslie Temperature Control Pilot had its "coming-out-party" recently at the Hessler Laundry, Paterson, N. J. The very first one of its kind ever made, it was installed at the Hessler plant back in 1933 by the firm's chief engineer, Bill Note—who also ordered the pilot's first overhaul in 21 years of continuous service.

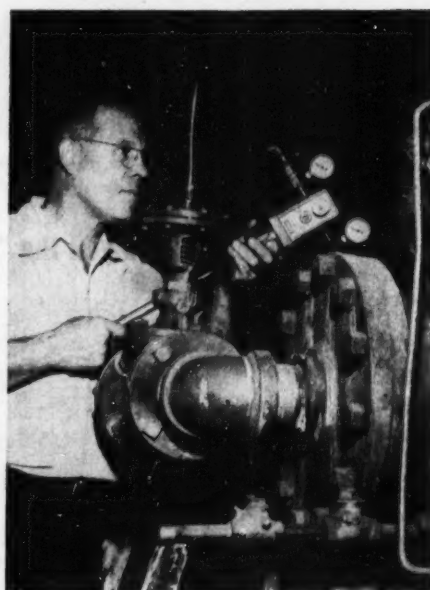
The pilot was designed to control constant process temperature over extended periods without necessity for recalibration or replacement of thermal elements. The Hessler field test worked out so well that the pilot was left untouched after its initial setting, for 21 years.

Periodic inspections showed the pilot was doing the job without appreciable wear or need for *any* attention. This year, it was removed from the heater for a complete examination and after a quick clean-up, it was put right back into service.

Top performance suggests other applications

The outstanding behavior of this first pilot is being repeated today by Leslie Pilots in hundreds of other applications in all industries. The wide adjustable ranges (32°-400°F and 300°-600°F) make the pilots adaptable to most operating conditions. The fast-responding bi-metallic element responds to changes as small as ¼°F.

LESLIE CO. 279 Grant Avenue, Lyndhurst, New Jersey



CHIEF NOTE REINSTALLS PILOT after no-cost overhaul. Parts showed no appreciable wear or corrosion after 21 years of continuous hot water heater service.

Send for Technical Data Sheet 464-14 describing Leslie Temperature Pilots and Controllers.



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LEVEL AND TEMPERATURE CONTROLS**

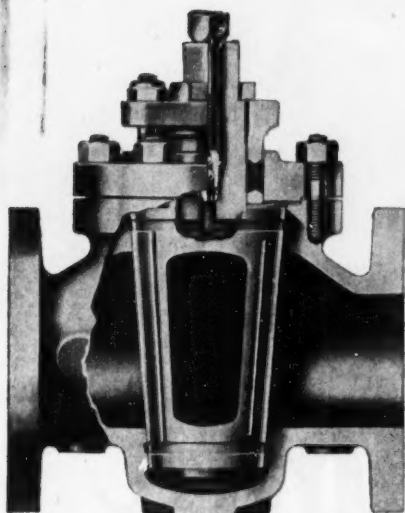
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Walworth Lubricated Plug Valves Offer These Advantages

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- Body and plug fully protected by lubricant from attack by line fluids.
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- Made in a complete range of sizes $\frac{1}{2}$ " to 26" and for pressures from 175 to 5,000 psi., and for vacuum requirements.

For handling petroleum products, natural or manufactured gas, acids, alkalies, solvents, slimes, slurries . . . in fact for almost any hard-to-handle liquids—there's a Walworth Lubricated Plug Valve designed for the job.

Easy to operate, tight sealing, resistant to wear and corrosion, Walworth Lubricated Plug Valves assure long years of dependable service at low operating cost.

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CHEMICAL ENGINEERING—February 1954

433



Fractions

SOLVE BIG PROBLEMS

The petroleum industry has made good use of the "divide-and-rule" formula that conquered kingdoms . . . to win command of the giant powers hidden in nature's oil. The industry's process engineers have transformed American life by their mastery of petroleum's secrets . . . and fractionating has been their master key.

These engineers' ability to develop processes which break petroleum into its component fractions has harnessed the "black gold" into a myriad forms of service. There have been other important results, too. The gigantic motor industry . . . America's vast network of modern highways . . . the services to motor travel—these are largely by-products of the petroleum process engineer's knowledge of fractional distillation.

For many years, Sun Ship has been adding to its own prestige by the service and cooperation its great shops give to the petroleum industry, and to the many other industries which call on Sun Ship's versatile engineering and construction skills. It has built . . . for chemical and petroleum process engineers, and for refineries throughout the world . . . the immense fractionating towers, pressure vessels, special machinery and heavy equipment they require. The 95'7" crude tower shown in the photograph, ready for shipment, is a representative example.

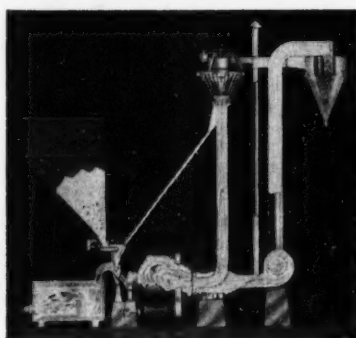
Sun Ship's services will continue to keep pace with the giant strides made by the nation's industries in the engineering progress which is steadily building a greater America.

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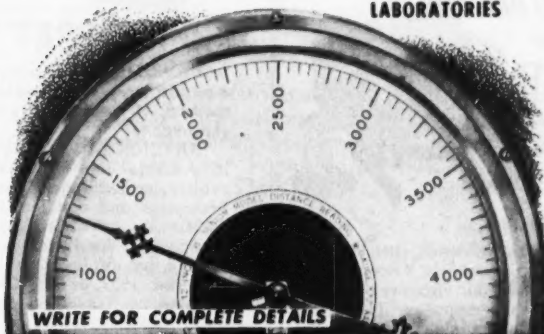
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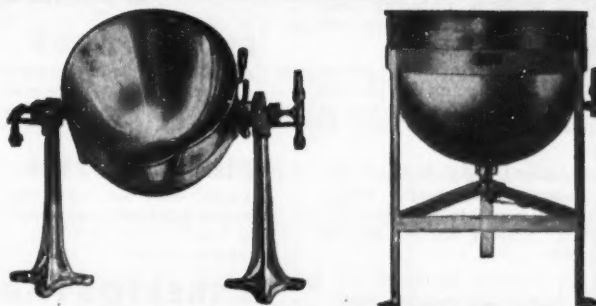
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VISCOMETER

Portable
Use in Lab,
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Just a flick of a switch, then read the dial, and with a Brookfield Viscometer on the job you have your viscosity determination directly in centipoises. The whole operation, including cleaning up, takes only a minute or two.

High accuracy plus high sensitivity are inherent in the Brookfield principle of operation — direct indication through a calibrated spring of the torque on a rotating spindle. Changes in viscosity as small as 1/5 of 1% of scale can be observed.

Ideal for use both in Labs and at points-of-process, Brookfield Viscometers plug in any ac outlet and are ruggedly constructed — have withstood the severest of service conditions the world over.

ADAPTABLE TO ANY PROBLEM FROM 1 TO 32,000,000 CPs.

Available in a variety of models — single speed, four speed, eight speed, explosion-proof, etc. — Brookfield Viscometers are suitable for work with both Newtonian and non-Newtonian materials.

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Accessory equipment such as the Brookfield UL Adapter makes possible measurements within .02 centipoises in the ultra-low viscosity range of .8 to 10 centipoises.

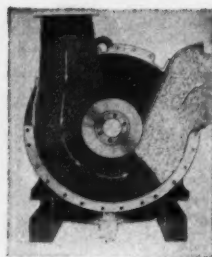
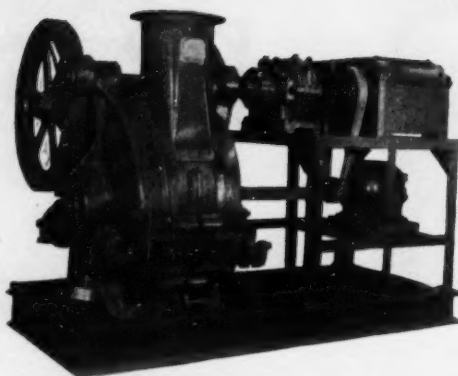
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If the problem is Viscosity Control
or Determination — ASK BROOKFIELD



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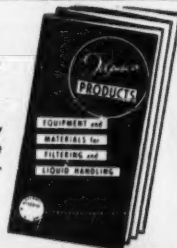
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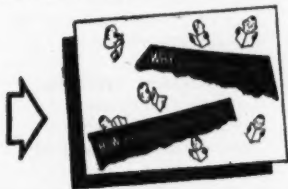
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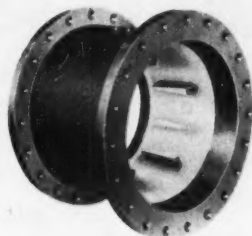
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The Flow Tube is an impact-type head meter designed for accurate measurement and regulation of fluid flow. It consists, essentially, of a short spool piece, the inner periphery of which is equipped with two groups of pressure nozzles, one group pointing upstream and the other downstream. The nozzle groups are inter-connected by common pressure rings from which connections are made to the high and low pressure sides respectively, of a conventional indicating, recording or integrating meter. Flow Tubes differ from other variable head meters in that the taps are located at points of equal cross-sectional area. Therefore, the differential developed is a function of the velocity head and independent of the static head.

Flow Tubes are compact, comparatively light weight, relatively low in cost, and are easy to install since they require straight runs entering and following only when installed near throttling valves or regulators. And, Flow Tubes are available in types and D/d ratios to provide differentials that can be accurately measured with the least head loss.

Flow Tubes are furnished with head capacity curves based on laboratory tests. These data furnished with each Flow Tube makes our guarantee of exceptional metering accuracy possible.

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For further information, write us, and for specific recommendations, send us necessary flow data.

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Whether you're interested in one or many products, simply circle the desired items on the reply card and drop it in the mail. Prompt attention will be given your requests.

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Sub-miniature potentiometer
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Accurate electrical settings in increments of $\frac{1}{4}$ to $\frac{1}{2}\%$ are easily controlled and are securely retained without the use of lock-nuts.

Vibration of 15G at 10-2000 cps or a sustained acceleration of 100G does not interfere with the dependable performance of the TRIMPOT.

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BOURNS designs and manufactures Linear Motion, Gage Pressure, Differential Pressure, Altitude and Acceleration Potentiometers.

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SUPER HIGH PURITY WATER

by the trouble-free
magic of ion exchange

No "bell outs" No "still odors"
No extras No heat or steam power



Penfield Mono-Column Demineralizer Model M-100. Purity of effluent: less than 2 ppm. Flow rate: 60-90 gph. Dimensions: $1\frac{1}{2}' \times 2' \times 7'$. Features inspection window that allows easy inspection of crucial middle distribution system.

Penfield Mono-Column Demineralizer Model MA-1000. Purity of effluent: under 1 ppm. Flow rate: 1000-1200 gph. Dimensions: $2' \times 5' \times 5\frac{1}{2}'$. Features automatic shut-off and signaling devices and fully automatic regeneration system.



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READY TO OPERATE ON ARRIVAL!

Available in a wide variety of mono and multi-column models (flow rates from 10 to 10,000 gph), all Penfield Demineralizers come equipped with regenerant tanks and all necessary gauges, flow meter, conductivity meter, etc. On arrival at site, simply connect the completely "packaged" unit to service lines and start receiving super high purity Penfield demineralized water.



Any model Penfield Demineralizer may be secured with automatic shut-off and signaling devices and a fully automatic regeneration system. Special control systems for the automatic maintenance of the purity of storage tank water supplies also available.

Write for fully descriptive catalog.

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Filters · Softeners · Degassifiers · Demineralizers

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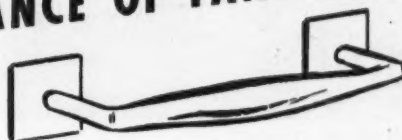
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"Buffalo" Fan
Balancing Room



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PROBLEM:

excessive vibration in exhaust fan delivering dust-laden air to cyclone. Fan operated smoothly a number of years, but gradually developed vibration and finally damaged the bearings.

SOLUTION:

Fan Wheel found to be far out of balance due to uneven buildup of slightly moist dust particles on blades. Fan rotor had never been cleaned, and had condition been permitted to continue, further bearing troubles and a sprung shaft might have resulted. "Buffalo" representative advised owner to clean rotor every six months, then check wheel balance. Fan has since operated smoothly, with no further bearing

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This is one of the thousands of problem-solution case histories accumulated in "Buffalo" files during our 77 years of building air handling equipment and solving air problems for industry. Call your nearest Buffalo Engineering Sales Representative—get the benefit of his factory trained "know-how" and experience to help you solve your air problems.

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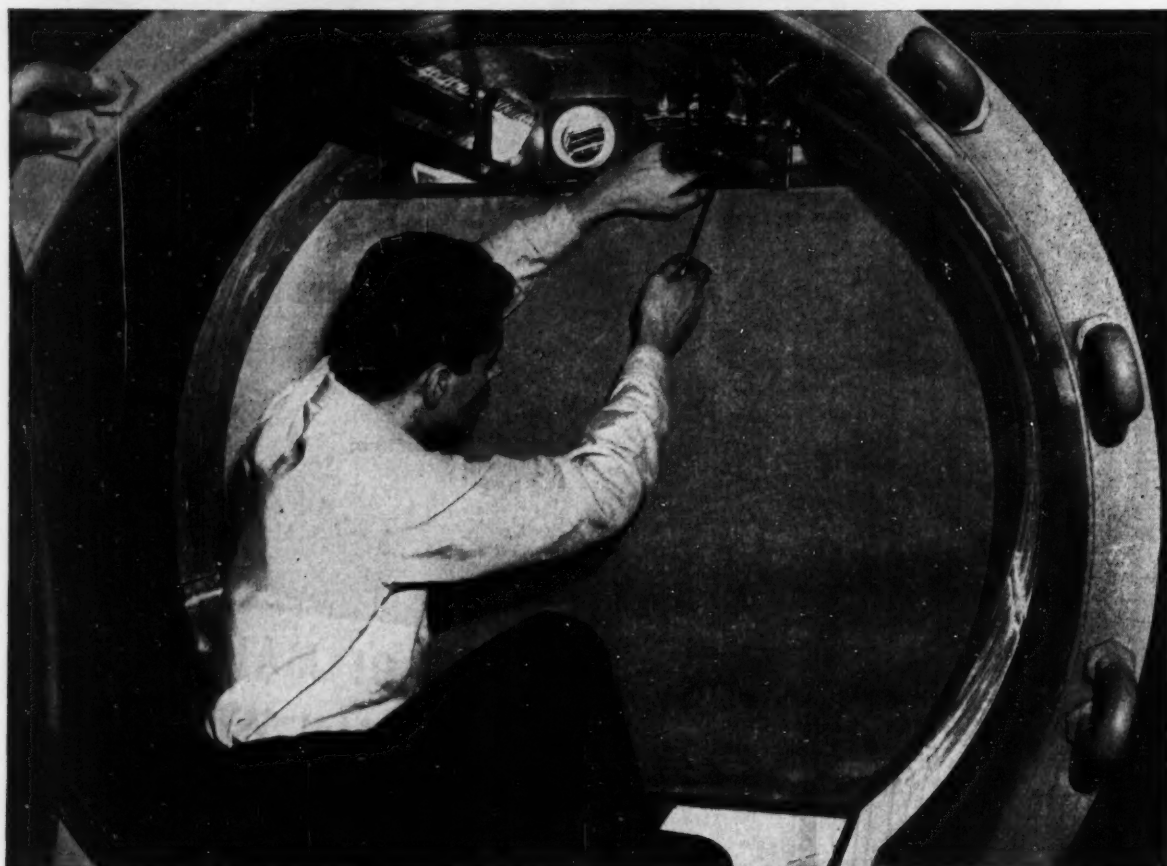
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Another new development using

B. F. Goodrich Chemical *raw materials*



B. F. Goodrich Chemical Co. does not make this industrial filter. We supply the Geon vinyl resin only.

CORROSION-RESISTANT PLASTIC REPLACES METAL—COSTS 66% LESS!

HERE'S another new use for rigid Geon vinyl plastic—one that improved the product and saved money to boot!

Formerly, expensive metal alloys were used to make essential parts of the leaf-type, acid filter pictured. But these metal parts would be eaten by corrosion—some in a matter of hours. Costly replacements and lost time ran up expenses.

So the manufacturer tried a rigid Geon vinyl plastic. He found it not only had the required corrosion resistance, but cost 3 to 4 times less than

special metal alloys. Now the filter leaf frames, nuts and bolts holding the leaves together, rollers holding the leaves in place, heel plate and various pipe fittings are all made from rigid Geon.

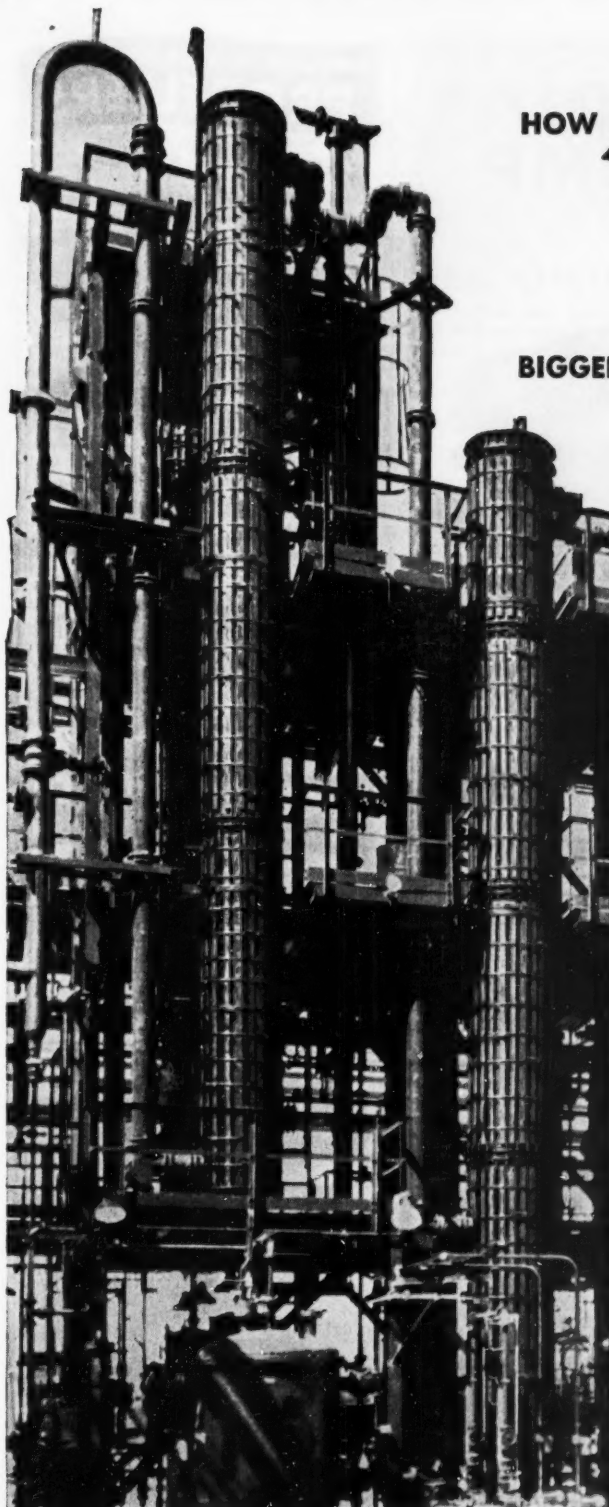
Versatile Geon vinyl materials have helped solve many problems. Products made from them can be either rigid or flexible, transparent or colored. And Geon resists acids, alkalis, most solvents and other chemicals, heat and cold. Let us help you select a Geon material suited to your needs—to help you improve or develop more saleable

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GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable.

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HOW



HELPS YOU BUILD

TOWERS

BIGGER, BETTER, CORROSION-RESISTANT

This was a big, exacting job for an old Haveg customer, and a good example of Haveg's usefulness as a material and a process equipment manufacturer. The project engineers specified towers of Haveg to eliminate their major problems in the fight against corrosion.

FIRST, WHAT IS HAVEG?

Haveg is a plastic material sold in finished process equipment, or as a cement for construction of plastic equipment in the field. It is not paint or a coating. Made from acid-digested asbestos bonded with special corrosion-resistant resins, Haveg is usually molded and cured into its finished forms: Cylindrical and rectangular tanks and towers, pipe and fittings, valves and pumps, fume duct systems, heat exchangers. Haveg takes high sustained temperatures (over 265°F. with a wide margin of safety). It resists thermal shock, seldom requires insulation.

HAVEG CAN BE BIG

Because Haveg is a molded plastic with adequate physical strength for self-supporting equipment, large equipment can be made. Diameters from 1/2 inch to a maximum of 10 feet can be built up in sections. The towers illustrated were assembled three and four high, with standard metal flanged connections. Metal inserts for connecting studs can be embedded in Haveg at the time of molding. However, most pipe connections are molded into the wall ready to take any standard pipe.

HAVEG WIDENS YOUR DESIGN RANGE

If you were to make a model of your next tower installation you would mold in many desirable features not usually possible with standard construction materials: More outlets, improved trays and distributors. When you build with Haveg all this becomes possible and practical. Haveg is inexpensively and rapidly molded into the design, shape, form you need to do a better chemical handling job. Openings, special bottoms are built into your tower sections by skilled plastics molders. Should your plans or processes change, Haveg can be machined and altered by you, on the job. Accidental mechanical damage is easily repaired, using Haveg cement and maintaining full chemical resistance.

KNOW THE FULL STORY

Haveg has a proven service record in the toughest chemical services, resisting most acids, salts, chlorine, many solvents. There's much more to tell about Haveg and the way it can help you. A 64-page illustrated Bulletin F-6 is yours for the asking. Contains size and chemical resistance charts, design specifications. Write today. Also, talk to the Haveg sales engineer whose office and phone is listed. Remember, Haveg is a logical answer to your design problem in towers; in fact, on all process equipment that touches corrosives.

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55 CFM Lindsay (GAS) Portable
60 CFM Worthington (GAS) Portable
70 CFM Smith (GAS) Portable
89 CFM 6 x 7 Worthington HP, 15 HP Elec.
105 CFM Worth-IR-CPT Portable
107 CFM 7-7 x 7 Ingersoll ES-1 STEAM
129 CFM 7½ x 7 American AF1, 20 HP
142 CFM Ingersoll Semi-Portable 25 HP
160 CFM IR-Worth—Portable
165 CFM Smith 110SR Semi-Portable, 25 HP
195 CFM 8-9 x 9 Worthington HS STEAM
210 CFM Worthington (GAS or DIESEL) Port
211 CFM 9 x 9 Worthington HB, 40 HP Elec.
279 CFM 11-10 x 11 Worthington HS STEAM
294 CFM 10 x 12 Worthington HB, 50 HP
315 CFM Worthington (GAS or DIESEL) Port
387 CFM Gardner Semi-Portable 100 HP
445 CFM Gardner Semi-Portable 100 HP
462 CFM 12-14½ x 13 American AF-S STEAM
500 CFM Worthington (DIESEL) Portable
538 CFM Worthington Semi-Portable, 100 HP
600 CFM Worthington (DIESEL) Portable
628 CFM 14 x 13 Ingersoll ES-1, 100 HP

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DRYERS—KILNS

- 3—Reeves 7'x160', 7'x120', ¾" shell.
- 2—Vulcan 8'x125', ¾" shell.
- 2—Allis Chalmers, 9'x80', ¾" shell.
- 1—Ruggles Cole 5'x30' Rotary Dryer.
- 7—Rotary Dryers 7'x60', 5'x67', 5'x40', 4'6"x50', 4½'x30', 4'x30', 4'x20'.
- 5—Link Belt, Hersey Rotary Dryers 27'x8', 3'x24', 3'10"x16', stainless and steel.
- 2—Hersey 6'x23', 5'x23' Rotary Dryers.
- 4—Louisville steam tube Dryers 6'x50', 6'x30', 5'x28', 3'x20'.
- 1—Buflovak single door vacuum shelf Dryer having 20—42"x42" shelves.
- 4—Devine single door vacuum Shelf Dryers having 20, 14, 6 and 4—40"x43" shelves.
- 3—Stokes and Buflovak Rotary Vacuum Dryers 30'x8', 3'x15', 5'x30'.
- 1—Single Drum 4'x9' Flaker.
- 4—Buflovak double drum 48"x108", 42"x90", 36"x84", 32"x52".
- 1—Buflovak 32"x52" double drum 316 SS.
- 2—Buflovak 6' dia. Crystallizers.

FILTERS

- 1—Oliver 1'x1' Rotary-Vac Filter 316SS.
- 2—Oliver Monel 8'x10' Rotary-Vac.
- 1—Oliver SS 8'x10' Rotary-Vac.
- 1—Eimco 4'x5' Rotary-Vacs complete with pumps, drives, piping, etc.
- 3—Oliver 5'3"x3' Rotary Vacuum Enclosed Precoat.
- 8—Oliver Rotary Vacuum 11'6"x18', 11'6"x14', 8'x12', 8'x10', 8'x8', 8'x6', 3'x1'.
- 1—Feinc steel 8'x12' Rotary-Vac.
- 2—Sweetland #12 with 72 and 36 leaves.
- 1—Sweetland #10 with 18 leaves.
- 1—Sweetland #7 with 27 leaves.
- 1—Industrial Filter 304 sq. ft. rubber-lined, 18 SS leaves.
- 3—Vallez 500 sq. ft. Rotary Pressure.
- 1—Sperry 36" Recessed, 48 chambers.
- 1—Shriver 36" P&F 42 chambers.
- 8—Sperry 24" P&F, 16 chambers.
- 1—Shriver 24" Recessed, 30 chambers.
- 3—Shriver 18" Recessed, 30 chambers.
- 2—Sperry Aluminum 30" and 24" P&F.
- 10—Shriver, Sperry Filter Press Skeletons 42", 36", 30", 24", 18".

CENTRIFUGALS

- 1—Bird 40" suspended, Stainless Steel.
- 1—Fletcher 40" Suspended, Stainless Steel.
- 2—Bird 40" Suspended, rubber covered.
- 1—Tolhurst 32" Suspended, rubber covered.
- 1—Fletcher 30" Suspended, steel.
- 1—Tolhurst 26" Suspended, steel.
- 1—Bird 36"x50" solid bowl, stainless.
- 4—Bird 36"x72", 36"x50", 18"x28" solid bowl, continuous.
- 2—Sharples #16P Monel and SS Super Centrifuges.

PULVERIZERS—CRUSHERS

- 4—Hardinge Mills 4½"x16", 5'x22', 5'x36", 6'x22".
- 1—Bauer 36' Attrition Mill 2-50 HP mtrs.
- 6—Patterson 6'x8', 5'x6', 4'x5', 2½'x3½' brick-lined Pebble Mills.
- 5—Abbe 3'x4', 3'x3½' Pebble Mills.
- 2—Premier Colloid Mills 8" dia., SS.
- 1—Eppenbach QV-8 Colloid Mill 2 HP motor.
- 1—Jeffrey 30"x24" Hammer Mill, Type A.
- 1—Rodgers, 10"x16" Jaw Crusher.
- 3—Raymond, Gayco Separators 12", 8" and 6".
- 2—Mikro #15I, #15H and #2TH SS.
- 2—Sturtevant 5"x8" Roll Crushers.

SPECIALS

- 1—Link Belt 705-20 Roto-Louvre Dryer, 316 S.S.
- 2—Pfaudler 1000 & 500 gal. glass lined jacketed agitated Reactors.
- 2—American 42" x 120" Double Drum Dryers.
- 1—Raymond 5 Roll High Side Mill.
- 1—Bird 40" Suspended Centrifugal, bottom discharge, Type 347 S.S.
- 1—#2TH Mikro Pulverizer, S.S.
- 1—Buflovak 32" x 52" Double Drum Dryer, 316 S.S.
- 1—Sharples Super-D-Canter PY-14, 316 SS, 10 HP motor.
- 1—Sharples Noxifactor DH-2, SS, 15 HP motor.
- 1—Patterson 40" x 84" Gyratory Sifter, single deck S.S.
- 1—Sharples C-27 Super-D-Hydrator S.S.
- 1—Komerak-Greaves Briquette Machine, 3 tons per hour.
- 1—Devine 2' x 4' Vacuum Drum Dryer, 316 S.S.
- 1—2800 gal. Horizontal Tank with coils, 316 S.S.

SCREENS—CONVEYORS

- 1—Patterson single deck 40"x96" SS.
- 5—Stainless single deck 40"x84".
- 3—#42 Rotex double deck 40"x84".
- 2—#12 Rotex double deck 20"x48".
- 5—Tyler Hummer 3'x5' triple deck.
- 4—Tyler Hummer 4'x15', 4'x10', 3'x10', 3'x5', single deck with V-16 Vibrators.
- 1—Abbe #2 Blutergess Sifter.
- 100'—12" Stainless Steel Screw Conveyor.
- 8—Bucket Elevators, steel housing 34' to 60' centers, 8"x5", 10"x6" buckets.

MIXERS

- 3—Baker Perkins 50 and 100 gal. Sigma Blades, jcktd.
- 1—Baker Perkins, 35 gal. SS jcktd.
- 1—Patterson 4' dia. Conical, steel.
- 1—Robinson 4000# steel powder.
- 6—Rodgers 400 to 3000# powder.
- 8—New Portable Agitators ¼ to 5 HP.
- 4—Day, Ross 8 and 50 gal. Pony.

KETTLES—STILLS CONDENSERS—TANKS

- 5—Pfaudler Reactors glass-lined 2000, 1500, 1000, 750, 500 gal.
- 6—Buflovak, Zarembo and Kilby Evaporators 300 to 14,000 sq. ft.
- 1—Lummus 4' dia. Steel Bubble Cap Column.
- 1—4' dia. Bubble Cap Column, copper and stainless.
- 6—Heat Exchangers, SS 50 to 570 sq. ft.
- 5—Bulovak Condensers 20 to 90 sq. ft.
- 3—Groen 125 gal., SS, jcktd., agitated Kettles.
- 1—2800 gal. 316 SS Tank with coils.
- 3—2300 and 1400 gal. Aluminum Tanks.
- 6—Glass-lined Storage Tanks 6000 and 8000 gals.

MISCELLANEOUS

- 7—Stokes Vacuum Pumps 10 to 100 CFM.
- 8—Stokes DD2, BB2, D4, D3 and B2, Rotary Tablet Machines.
- 5—Nash TS12, TS8, L3, AL672, #4 Vacuum Pumps.
- 4—Olivite, Durion rubber and stainless steel Centrifugal pumps 6" to 1".



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- 1—Louisville steam tube pilot size, s.s.
- 1—6x40 Direct Heat
- 1—6x50 Louisville Steam Tube
- 1—Grube 8'x22, steam tube.
- 2—3 1/2'x7' & 6'x9' Rotary Kilns.
- 1—8'x35' Louisville steam tube.
- 1—Davenport #3A bronze rotary Press.

Centrifugals and Clarifiers

- 1—32" Tolhurst suspended rubber perf. basket.
- 1—48" Tolhurst susp. steel perf.
- 1—40" Tolhurst suspended rubber covered perforate basket.
- 2—De Laval 54-81 Clarifiers, 3 hp.
- 3—Sharples airtight clarifiers, stain. steel.

Evaporators and Vacuum Pans

- 1—40 sq. ft. 316 SS Single Effect.
- 1—Alberger 1500 sq. ft. SS Condenser.
- 1—Peebles triple effect, stain. steel.
- 1—20 gal. Stokes st. steel Vacuum Pan.
- 1—Swenson sq. ft. Evap. 120 sq. ft.
- 1—Swenson quad. eff. Evap., 350 sq. ft.
- 1—Saramba trip. eff. Evap. 150 sq. ft.
- 1—Swenson trip. eff. Evap., 850 sq. ft.

Filtration Equipment

- 1—Oliver Filter 1x1', 316 stain. steel.
- 12—Cast iron recessed plate and frame Filter Presses, 7" to 36".
- 1—Aluminum 30" 40-chamber P&F. press.
- 1—Lead 24" 38-chamber P&F. press.
- 1—Oliver 8x14' Filter.
- 1—Oliver pressure, iron, 110 sq. ft.
- 5—Alsop, Lomax internal pressure Filters, stain. steel and bronze.

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MILLS

- 1—Hardinge 36" x 5' continuous Pebble Mill.
- 1—Jeffrey 35 hp. Hammer Mill.
- 1—Williams 518 No-Nile Hoq.
- 1—Williams type AK 40 hp. Hammer Mill.
- 3—Mikro Pulverizers: #1SH, 15L.
- 1—Attrition, Sprout-Waldron 20".
- 12—Pebble and Jar Mills, 1 to 235 gal.
- 3—Colloid Mills and Homogenizers.
- 1—Raymond 3-roll high side.
- 10—Hammer Mills, 3/4 to 50 hp.
- 6—3-roll Mills, Day, 12x32" and 16x40".

MIXERS

- 1—Day #6 single arm, stain. steel.
- 2—50 gal. s.s. Kettles, dbl. act. agitators.
- 1—Day 1 bbl. stain. steel, single arm, jacketed, vacuum cover 3 hp.
- 2—Day Pony Mixers, 40 and 15 gal.
- 1—Abbe Lenart 5 and 110 gal.
- 1—Colton #6 s.s. Granulating.
- 1—Headco 250 gal. work. cap. stain. steel dbl. arm, 50 hp.
- 7—Baker-Perkins, Read, Lynn-Superior double arm, up to 100 gallons.
- 10—Day, Robinson Powder type, 50 to 2000#.

TANKS

- 30—Stainless Steel (some with agitators), new and used, up to 10,000 gal.
- 2—1000 gal. steel jacketed (100 psi.) open top.

MISCELLANEOUS

Screens: Rotex, Selecto, Tyler-Hummer.
Heat Exchanger: Karbate 18.5 sq. ft.
Vacuum Pumps: Stokes 105 CFM.
Sanitary Pumps: Waukesha size 55, 100.

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- Buslovak Double Drum Dryer—32" x 52" complete
- Buslovak Double Drum Dryer—32" x 72" complete
- Buslovak Double Drum Dryer—32" x 100" complete
- Mikro 2 TH Pulverizer.
- Mikro 3TH Pulverizer.
- 12" P & F Bronze Filter Press.
- 12" to 36" P & F or REcessed Filter Presses.
- In Stock At All Times: New & Used Kettles 2 1/2 to 1000 gallon S/S or plain steel.
- Abbe Lenart Mixer—5 gallon capacity. S/S jacketed w/motor.
- Abbe Lenart Mixer—110 gallon capacity. S/S jacketed w/motor.
- 2-6000# Ribbon Mixers-Jacketed.
- Portable Agitators w/new motors.
- Additional Mixers in stock—Ribbon & Sigma Blades. Laboratory to 5 ton size.
- 40 gallon new S/Clad Kettles. Complete. 40 gal. \$180.00 ea.

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- 1—Eppenbach Stainless Steel Home Mixer, complete with 3 1/2 HP Explosion-Proof Motor.
- 1—Baker-Perkins 100 Gal. Stainless Steel Mixer, double-arm, sigma blades, with 20 hp explosion-proof motor.
- 1—J. H. Day #2, 75 Gal. Brighton Mixer.
- 1—Pebble Mills 40 to 600 Gal.
- 10—Pony Mixers, 8, 15 and 40 gal.
- HIGH SPEED Roller Mills 9"x24" to 18"x48".
- 1—Motor Driven Belt Conveyor.
- 1—6" Premier Colloid Mills, watercooled.
- 2—225 Mikro-Pulverizers with 10 hp Motors.

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- Pfaunder Glass Lined Jacketed Reactor, 400 gal. 4'x4'; chemical glass.
- 2—Stainless Processing Kettles, 6' dia. x 5'10 1/2" deep plus cone bottom 2'4 3/4"; with agitators all in Stainless.
 - 3—Steel Horizontal Tanks; 8'x30" w/1 1/2" Steel bumped heads; with coils and saddles.
 - 1—Niagara Stainless Pressure Filter; Model 110-20.
- Baker Perkins Ter-Meer Type S12 Stainless Continuous Centrifuge.
- Sprout Waldron PNEU-VAC Material Handling System in Type 316 S/S.

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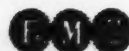
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3655 W 2—Four Fitzpatrick Model D Stainless Commutators.

14—Patterson and International Pebble Mills; 6'x5'; 6'x8' and 8'x8'.

16—W&P. Type Jacketed Heavy Duty Double Arm Mixers; 100 gal. and 150 gal. working Caps.

6—Sperry Aluminum Filter Press; 18", 30" and 36" in excellent condition.

17—New and Unused Stainless Steel Tanks with agitators; 1,000 gal. and 2,000 gal. at great reductions below today's market prices.

20—Hammer Mills by Mikro, Gruendler, Fitzpatrick, Williams, Jeffrey, Sturtevant, Robinson, etc.

Bird Continuous Centrifuge, 18"x28".

Majonnier Stainless Vacuum Pan, 3'x10".

Charlotte No. 50 Manel Jacketed, Colloid Mill.

Sprout Waldron Continuous Mixer in Stainless; 28"x12" long.

Stainless Lab. Autoclaves or Reactors; 5'x 12"; 10'x15"; 18'x18"; Jkted.; Agtd.

20—Hammer Mills by Williams, Jeffrey, Mikro, Gruendler, Fitzpatrick; all sizes.

470 gallon Stainless Jacketed Agitated Kettle; 4'x5' (type 316 S/S).

Combustion Engineering Flash Drying System; 2 stage; 1500 lbs. per hour.

1—Tolhurst Stainless 40" Suspended Type Centrifugal Extractor; 2 speed motor.

2—Bird 48" Suspended Type, Rubber Covered Centrifuge.

General American Twin Drum Dryer 42"x 120", complete with accessories.

Pfaunder Glass Lined Jacketed Reactor, 400 gal. 4'x4'; chemical glass.

2—Stainless Processing Kettles, 6' dia. x 5'10 1/2" deep plus cone bottom 2'4 3/4"; with agitators all in Stainless.

3—Steel Horizontal Tanks; 8'x30" w/1 1/2" Steel bumped heads; with coils and saddles.

1—Niagara Stainless Pressure Filter; Model 110-20.

Baker Perkins Ter-Meer Type S12 Stainless Continuous Centrifuge.

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- 3—Baffle Plate or Cascade Columns or Towers, T304 stainless steel, 5' dia. x 50' high.
- 2—Sections 6' dia. St. St. Baffle Plate Column.
- 3—Aluminum Bubble Cap Columns, 36" dia. x 45 plate; 27" dia. x 18 plate.
- 1—Aluminum Perforated Plate Column, 28" dia. x 36 plate.
- 1—Copper Column with 18–30" dia. perforated plates and 10–24" dia. bubble cap plates.

CONDENSERS—EXCHANGERS

- 3—St. St. Pipe Coolers—73, 78 & 400 sq. ft.
- 15—Alum. Coil Exch., 47 sq. ft.
- 7—Copper tub., 65, 90, 140, 1350 sq. ft.
- 6—S.S. Tubular Exchangers 14, 55, 70, 160 & 400 sq. ft.
- 1—Steel Shell & Tube, 1000 sq. ft.
- 3—S.S. Coil Condensers, 40 & 55 sq. ft.

FILTERS

- 2—International T304 St. St., #3 (24" dia.) and #5 (33" dia.)
- 1—Sweetland #10, 21 leaves, 3½".
- 1—Sweetland #12, 72 leaves, 2".
- 1—Swenson Rotary Continuous Vacuum Filter; Precoat type, 8' dia. x 8' face, rubber covered and lead acid proof.
- 1—FEINC Aluminum Rotary Vacuum string discharge, 46" dia. x 6'.
- 4—Pressure Leaf Filters, 70 to 140 sq. ft.
- 1—Shriver 36" C. I. P&F., 20 ch. cl. dly.
- 1—Sperry 24" C. I. Filter Press, 16 Ch.
- 1—Louisville 8-roll Continuous Filter or Grains Press, 24".

KETTLES—REACTORS

- 8—15,000 gal. Steel Reactors, with coils and 40 HP agitator.
- 1—450 gal. Monel Tank, ¼", with coils.
- 3—13 gal. Autoclaves, T347 St. St., 700# int. WP., 50# Pkt. WP.
- 1—St. St. T304 Pressure vessel, 18" dia. x 9'4" long, 600# W.P.
- 2—450 gal. Stainless Steel Kettles, Jktid. & Agit.
- 70—Stainless Steel and Stainless Clad open top, steam jacketed kettles—40, 60, 80, 100, 150, 500 gal. sizes.
- 4—Aluminum Reaction Kettles, Jktid. & Agit., 35, 60, 100 gal. and 250 gal.

MILLS—PULVERIZERS

- 1—Kennedy Van Saun 3' x 6' Air Swept Contin. Ball Tube Mill.
- 1—Williams Hammer Mill type AK; size A, stainless steel.
- 4—Mikro Pulverizers, #1-SH, #1-SI #2-SL, #2-TH.
- 1—Premier Colloid Mill, 6" st. st.
- 1—Acme #8½A Jaw Crusher.

JUST PURCHASED

- 1—Monel Tank, 3500 gal., 6' dia. x 16' H; 3/16" & 1/4"
- 2—Stainless Steel Vertical tanks 6000 gal.; 10' D; 1/4" & 7/16"
- 1—Steel Reboiler, 5' D x 8'6" L
- 1—Stainless Steel Packed Column, 14" D x 25' H
- 1—Ribbon Powd. Mixer, 280 cu ft.
- 3—Ribbon Powd. Mixers, 40 cu ft.
- 1—Fitzpatrick Model D-6 Comminuter, St. St., 15 HP motor.
- 1—Resina Auto. Screw Capper, for pt., qt. and gal. cans.

TANKS

- 35—Aluminum Tanks closed, 4, 275, 330, 480, 500, 1350, 1450, 2300, 2700, 3000, 4100 and 9000 gal.
- 50—Horizontal Welded Steel Tanks from 3800 gal. to 21,700 gal. sizes.
- 1—Vertical Rubber Lined, 6000 gal. open.
- 8—15,000 gal. Vertical Welded Steel Closed Fermenting Tanks, 80 lbs. WP., turbine agitator with 40 HP motor; 970 lin. ft. 3" pipe coil. Excellent condition.

STAINLESS STEEL TANKS

- 3—T347 Pr. or Vac.—50 & 235 gal.
- 2—T316 Pr. or Vac.—35 & 160 gal.
- 11—T304 Pr. or Vac.—2½, 9, 150, 160 & 260 gal.
- 1—T304 600# pr.—88 gal.
- 50—Stainless Steel Storage Tanks— from 15 gal. to 8200 gal. sizes.
- 1—3000 gal. Horizontal Stainless Steel Tank, 5'4" dia. x 18'9" long, insulated and agitated.

MISCELLANEOUS

- 1—St. St. Bin, T316, 275 cu. ft. cap.
- 1—AT & M Susp. 48" Centrifugal, Perl. Basket, Bottom discharge, T-304 s.s.
- 1—Bird Susp. Centrifugal, 48" dia. Perforated Basket, T347 St. St.
- 5—DeLaval Centrifuges, models #600, 74-11 and 94-01.
- 1—B & J #1½ Rotary Cutter, St. St.
- 3—Witteham Co. Atmospheric Double Drum Dryers, 22" x 38".
- 2—Kux Machine Co. Model 25 Rotary Pellet Presses, 21 and 25 punch.
- 4—Selectro Vibrating Screens, stainless steel, 2' x 7', double deck, enclosed.
- 1—Stokes Vertical Steel Jacketed Vacuum Chamber and Impregnating tank, 30" L x 25" W x 24" D.
- 2—Vertical Agitators—40 HP gearmotor with Turbo #5B drive, 70 RPM.
- 1—Baker-Perkins #14-JEM Universal Mixer, Jacketed, Vacuum Cover, 50 gal. work, cap., 50 HP motor.
- 1—Porter heavy duty jacketed double worm mixer—75 gal.
- 140—St. St. Flanged Gate Valves, 1", 1½", 2", 2½" x 3".

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Make	Size	Type	Max Press	Max Cap
Commerville	8 x 20	RCS	1 1/2	600
Roots-Commerville	20 x 60	SF	2 1/2	6040
Roots-Commerville	36	AF	3	70
Roots-Commerville	47	AF	3	124
Roots-Commerville	57	AF	3	200
Roots-Commerville	22 x 36	RCDH	6	5590
Sutorbilt	6M	M	6	189
Roots-Commerville	18 x 12	RCD	10	910
Roots-Commerville	14 x 18	RCD	10	950
Sutorbilt	6H	H	10	128
Roots-Commerville	24 x 23	RCGH	10	7200
Roots	27 x 30	Gie Pump	10	7600
Roots-Commerville	32 x 32	RCGH	10	14700

38 OTHERS IN STOCK

TURBO BLOWERS

Make	Size	HP	Volume CFM	Pressure (oz)
Sturtevant	170-225	75	10,100	13
Gen. Blower	1630	75	4,500	16
Spencer	1015	15	2,000	16
Spencer	1215	15	1,675	20
Ingersoll-Rand	FS-377	85	15,000	20
Ingersoll-Rand	FS-377	150	10,500	20

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Spencer	1060-H	75	1,700	80
Allen-Billmeyer	DA-8	15	225	96
Allen-Billmeyer	ED5B-5	30	410	96

66 OTHERS IN STOCK.

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Make	Type	Size	Type 1 Wheel Diam.
Clarage	IE	15	Open
American	E	35	Open
New York	GI	33	Open
Clarage	IE	23	Open
American	EIS	55	Open
Aladdin	EX	42	Open
Sturtevant	DES 3	70	Open
Sturtevant	DES 1	70	Open

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SATISFYING YOU IS OUR BUSINESS

- 2—Blow Knox Autoclaves 100 Gal. 2000 psi.
- 10—Shriver & Sperry Filters 12" to 30".
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- 1—Sweetland #12 Filter, Brze Leaves.
- 1—Read 100 Gal. D.A. Jack. Mixer.
- 1—B.P. 20 Gal. D.A. Jack. Mixer.
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- 1—Stainless Steel Condenser 368 Sq. Ft.
- 1—Bird 48" Sus. Style S.S. Centrifuge.
- 1—Bufflovak 6' Jack. Vac. Crystallizer.
- 1—Pfaudler 500 Gal. Reactor.
- 7—S.S. Kettles 100 to 300 Gal. w/Ag.
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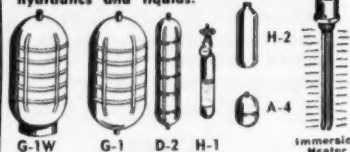
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SPECIAL OFFER! 0-500 lbs. pressure gauge with standard 1/4" pipe thread back opening—when purchased with tank or cylinder, \$1.00 each. When purchased separately, \$2.95.

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Electric Immersion Heater 115 v. AC, ideal for heating oils, liquids, chemicals, etc. Three heats 300-600 or 1200 Watts, 14" length. Screws into any tank with standard or 1 1/4" pipe thread or can be merely inserted in any container. Complete with 8 ft. Neoprene cord, heater only. . . . \$8.95
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- Dryers: 4'x20', 5'x35', 6'x40', 6'x60' & 90'x60'

MISCELLANEOUS EQUIPMENT

- Hammer Mills: Jeffery 36x248, 75 HP Motor.
- 6'x15' & 7'x17' Autoclaves.
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- 5'-3"x8"-D' Rotary Vacuum Filter.
- 40'x30" Dorr 3 Tray, 4 Compartment Thickener.
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New Advertisements

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- 1—Robbins Vibrex 3x6 Vibrating Screen, single deck.
- 1—Copper Evaporator, steam jacketed, 9'1"x3'9".
- 60—New Pressure Cookers, 18"x18" & 24"x28".
- 50—Pumps—steam and electric.
- 1—New Glass Nash Centrifugal Pump, 160 gpm.
- 1—Jeffrey Vibrating Conveyor 15' lg. 12" wide.
- 1—Bufflovak Jacketed Impregnating Tank 42"x52".
- 1—4x8 Sturtevant Jaw Crusher.
- 1—Ribbon type Mixer, steam jacketed.
- 1—Model 16 Sharples Stainless Steel Centrifuge.
- 3—New Drum Rollers.
- 2—Nash Air Compressors, Type AL-623.
- 1—Manton Gastin Stainless Homogenizer, 125 gph.
- 3—French Oil Mill Lard Cookers.
- 1—Shriver 18" Aluminum Filter 9-plates 9-frames.

H. LOEB & SON

- 1—Rotary Dryer direct fired 54"x30'6".
- 1—Kennedy-Van Saun Rotary Dryer, 4'x40'—brick lined.
- 10—New Sharples Oil Purifiers.
- 1—2316 Stainless Reactor, 265 gals. cap. jacketed.
- Abbe Pebble & Tube Mill, 5'x22"—Burr-Stone Lined.
- 1—Patterson Ball Mill, porcelain lined, 17"x27".
- 3—Dorr Kettles with agitators, 600 gal. cap.
- 1—Ribbon Type Mixer, 30" dia. 10' lg. center discharge.
- 2—Large Steam Jacketed Horizontal Mixers.
- Robinson Pulverizer #20, with 2 motors 10 HP each.
- Robinson Ribbon Type Mixer, 30"x10"—like new.
- 6—Steam Jacketed Blackburn-Smith Filters.
- 2—Crystallizers—10' long.
- 2—300 ton Hydraulic Presses.
- 3—3,000 gal. Jacketed Kettles with Turbo Agitators.
- 1—300 gal. Double Arm Mixer—jacketed.

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- 3—Tolhurst 40" & 26" s/s sus. centrifuges
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- 1—Stokes 650 gal stainless vac pan or reactor
- 3—750 gal stainless 316 agtd & coiled reactors
- 2—250 gal Blaw Knox jkted & agtd ASME steel reactors 100#
- 1—2200 gal stainless clad jkted kettle
- 3—Baker Perkins 500 & 100 gal jkted double arm mixers
- 1—Paterson 8' conical blender, 25 HP explosion-proof motor.
- 1—Ross 92" heavy duty putty chaser, 20 HP geared motor
- 5—Stainless steel 3' x 8' & 2' x 8' Niagara sifters
- 4—Devine & Bullovak vac shelf dryers, 20, 17, & 13 shelves
- 2—Bullovak 24" x 36" & 32" x 52" double drum dryers

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- ★ Karbate Heat Exchanger, 178-1 1/2" tubes 566 ft.
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- ★ Moore 4' x 5' Ball Mill, 15 HP, t.e.f.c. mtr.
- ★ Moore 3' x 4' Ball Mill, 10 HP, t.e.f.c. mtr.
- ★ Sperry 18" bronze Filter, 25 rec plates
- ★ Ruggles-Cole 90" x 60" Dryer, type XF-14
- ★ Sedberry #3 Hammermill, 10 HP motor
- ★ Williams size B Hammermill, 50 HP, 3600 RPM
- ★ Day 3 Roll Mill, 12" x 32" Wtr cld, 10 HP
- ★ Baker-Perkins 20 cu ft Dbl arm Sigma Mixer
- ★ Fletcher 40" Centrifugal, 15 HP solid steel
- ★ S.S. Heat Exchanger, 36-1 1/2" tubes, 16' long
- ★ S.S. Heat Exchanger, 36-1 1/2" tubes, 16' long
- ★ 300 Gal. Pfaudler Reactor, 316 S.S.
- ★ Devine Shell Dryer, 5 shelves, 38" x 44" Comp.
- ★ Proctor-Schwartz Apron Dryer, S.S. 8' x 90"
- ★ Tyler-Niagara Screens, 36" x 72", 1 deck
- ★ Tyler Ty-Rock 4' x 8' 1 deck, enclosed
- ★ Eimco 8' x 8' rot. Vac. Filter, Complete
- ★ 2-Gump 44-26 Electric Gr. Feeders, New
- ★ Bullovak 42 x 120 Double Drum Dryer
- ★ Vulcan 48" Dia. Still, 30 bbl cap stl pits
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- ★ Micro 24" pulverizer, screw feed, 40 HP
- ★ Sharples Py-14, Super-D-Cantor, S.S. 10 HP
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Bullovak #12 Vac. Dryer, 40 x 42 shelves
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2—AT&M 60" Centrifugal Extractors, 316 SS link suspended with 10 HP AC motors
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 DRYER—Single Drum, 5'x6'.
 DRYERS—Conveyor, 2'x28", 8'x40", 6'x4'x43', 8'x94', 55 16'x85'.
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 KETTLES & REACTORS—Steel, 2800 gal., 1700 gal., 1000 gal.
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 100 to 200 gal. S.S. Mix Tanks, water jkt.
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 Stainless Steel Type 316. Good condition.

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- 1—Sparkler Type 316 S.S. Jacketed Filter, Model 33-D-17.
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- 1—Sparkler S.S. Jacketed Filter, Model 18-D-8.
- 1—Bird-Young S.S. Filter, 3'x3'.
- 1—Niagara Stainless Steel Filter, Model 136-46.
- 1—Nooter Stainless Steel Jacketed Vacuum Reactor, 500 gal.
- 1—Stainless Steel Jacketed Vacuum Reactor, 500 gal. with Anchor type Agitator and Drive.
- 1—Link Belt Roto-Louvre Steel Dryer 7½' x 20'.
- 7—Haveg 2000 gal. Storage Tanks.

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- 1—Bufflovak Vacuum Double Drum Dryer, 24" x 48".
- 1—Stokes Rotary Vacuum Dryer, 3' x 12'.
- 1—Vulcan Rotary Klin, 7'x120'.
- 7—Devine Vacuum Shelf Dryers, 5' & 9 Shelves.
- 1—Bufflovak Vacuum Shelf Dryer, 20 Shelves.
- 1—Bufflovak Double Drum Dryer, 32"x90".
- 1—Louisville Steam Tube Dryer, 6'x50'.
- 2—Bufflovak Vacuum Drum Dryers, 24"x20'.
- 1—Devine Rotary Vacuum Dryer, 5'x25'.
- 2—Bufflovak Double Door Vacuum Shelf Dryers, 20 shelves each.

FILTERS

- 1—Sweetland #2 Stainless Steel Filter, 12-16" Leaves, 28 Sq. Ft.
- 1—Schrivver 42"x42" C.I., P.F. Filter Press, 60 chamber, open delivery, with hydraulic closing.
- 2—Oliver Rotary Vacuum Filters, 5'3"x6', Steel Construction with Monel Screens.
- 1—Oliver Homogenous Lead Filter, 8'x8'.
- 1—Sperry Aluminum Plate & Frame Filter Press, 42"x42", Closed Delivery, 3" Frames, 35 Chambers.
- 1—Bird 24" Monel Screen Type Centrifugal Filter.
- 1—Schrivver Stainless Steel Filter Press, 24"x24", Closed Delivery, 10 Chambers.
- 1—Sperry 42" C I Plate & Frame Filter Press, 16 Chambers, Closed Delivery.
- 5—Sweetland Filters, #2, 5, 7 and 12.
- 1—Oliver Rotary Filter 3'x1'.

CENTRIFUGALS

- 1—Fletcher Stainless Steel Suspended Type Centrifuge, 40" Perforated Basket.
- 2—A. T. & M. S S Susp. Centrifuges, 48" Imperforated Baskets.
- 1—De Laval 17" Multi-Matic S.S. Centrifuge with 15 HP Motor.
- 2—Ellis SS Centrifuges with 30" perf. Baskets.
- 6—Sharples #16-Y Stainless Steel Super-Clarifying Centrifuges.

MIXERS

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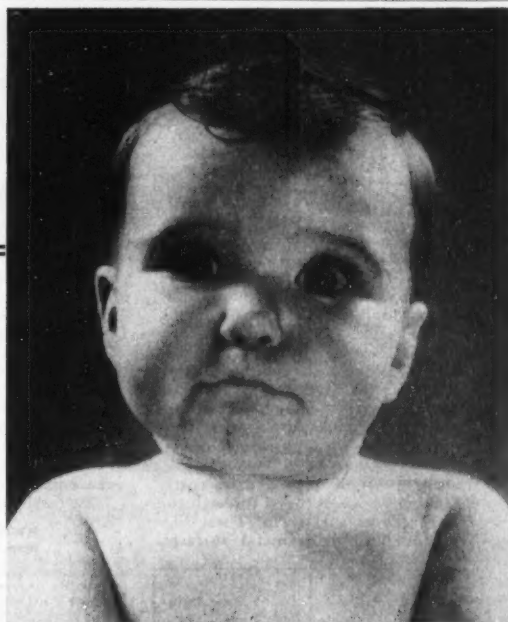
- 1—Baker Perkins Stainless Steel Dispersion Mixer, Size 15, Type VUMM, 100 Gals.
- 8—1-HP Explosion Proof Gear Head Mixers with Stainless Steel Type 316 Propellers & Shaft, 445 RPM.
- 1—Struthers Wells Double Arm "Northmaster" Mixer, 50 Gals. Working Cap., 100 Gals. Total Cap.
- 5—Simpson #20 Intensive Mixers.
- 3—Day #30 Imperial Jacketed Double Arm, Sigma Blade Mixers, 75 Gal. Working Cap.
- 2—J. H. Day Jacketed Powder Mixers, 800 lbs. each, with 5 HP Gear Head Motors.
- 1—Simpson #1 Intensive Mixer.
- 4—Baker Perkins Steel Jacketed Mixers, Sigma Blades, 100 Gals.
- 3—Baker Perkins Stainless Steel, Jacketed Mixers, Sigma Blades, 100 Gals.
- 3—Turbo Steel Jack. Mixers, 700 Gals. Each.

PULVERIZERS—GRINDERS—MILLS

- 1—Abbe #80 Rotary Cutter with 3 HP Motor.
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- 1—Mikro #3TH Mikro Pulverizer with 30 HP Motor.
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- 1—Abbe #2 Master Rotary Cutter.
- 1—Ball & Jewell #20 S.S. Rotary Cutter.
- 2—Ball & Jewell #2 Rotary Cutters.
- 1—Blaw Knox Air Mill Pulverizer.
- 1—Mikro Stainless Steel Atomizer #6.
- 3—Tropp 2-Roll Rubber Mills, 18"x50".
- 1—Abbe #2 Buhrstone lined Pebble Mill, 5'x4'.
- 1—Gruendler #24-40 Hammer Mill.

AUTOCLAVES—KETTLES—TANKS

- 1—Stainless Steel Crystallizing Tank, 6,000 Gals.
- 1—Pfaudler 500 Gals. Jacketed Vacuum Reactor.
- 1—Combustion Engineering Stainless Steel Jacketed Autoclave, 500 Gals., 300 PSI.
- 1—Pfaudler glass lined, open storage tank, 2000 gal. capacity.
- 2—Pfaudler Glass lined Jacketed Vacuum Reactors, 200 gal. each.
- 1—Pfaudler Glass lined Jacketed Reactor with Anchor Type Agitator & Drive. Unused. 500 gal.



THE GELB BOY . . . FEBRUARY, 1954

- 4—Pfaudler Glass Lined Jacketed Vacuum Reactor with Agitator & Dryer, 30, 50, 1000 gal., (unused).
- 8—Pfaudler & Glasco Glass Lined Vacuum Receivers, 10, 25, 30, 100 gal. cap. each. (unused).
- 2—S.S. 200-gal. Jacketed Vacuum Reactors.
- 1—450 gal. Stainless Steel Jacketed Kettle.
- 12—Kovan Stainless Steel Jacketed Vacuum Kettles, 380 Gals. Cap. Ea.
- 1—Struthers Wells Steel Jacketed Vacuum Reactor, 1800 Gals. Cap. with Drive, Turbine Agitator & Collis.

- 1—Readco type 316 Stainless Steel Jacketed Powder Mixer, 1000# Cap., 125# Jack., ASME Constructed.
- 1—Swenson-Walker type 316 S.S. Jacketed Crystallizer, 4—10' Sections.
- 1—Type 316 Stainless Steel Tank with Coils, 1000 gals., dished head.
- 1—Bufflovak type 347 Stainless Steel Rotary Vacuum Dryer, 5' x 20'.
- 1—Baker-Perkins, Steel Jacketed, Double Arm Sigma Blades, 200 gal. working capacity. Year built 1948.

- 1—Monel Storage Tank, 1,300 Gals.
- 2—Blaw Knox Steel Jacketed Autoclaves, 300 & 500 Gals. Cap., P.S.I. Working Pressure 500 Lbs.
- 1—Patterson Steel Jacketed Autoclaves, 900 Gals. Cap., Internal Pressure 120 Lbs.
- 1—Artesian Steel Jacketed Kettle, 1,000 Gals. Cap., with Rake Type Agitator, ASME Code, 50 Lbs. Pressure.
- 2—J. P. Devine Jacketed Vacuum Reactors, 2,000 Gals. Cap. Each.
- 1—Buffalo Steel Pressure Tank, 10,000 Gals. Cap., 125 P.S.I., ASME Coded.
- 25—Steel Storage Tanks, 9,000-17,500 Gals.
- 1—Steel Rubber Lined Storage Tank, 4,500 Gals. Cap.

MISCELLANEOUS

- 2—Downington Stainless Steel Heat Exchangers, 500 Sq. Ft. Each.
- 1—Watson Stillman Hydraulic Press, 12"x12", 30 Ton.
- 1—Nash Hytor Vacuum Pump, Model #H-4 with 25 HP Motor.
- 1—Roots Connorsville Blower, Model #HD, Size 16" x 12".
- 3—Nash-Hy-Tor Vacuum Pumps Model No. T.S.-12.
- 7—Alco Heat Exchangers, 360 Sq. Ft.

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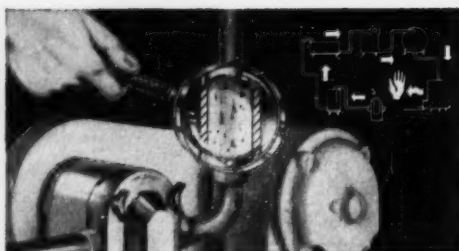
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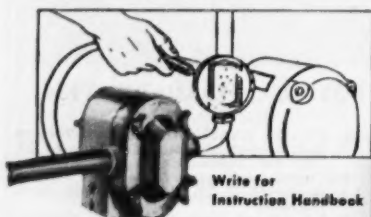


eventually wearing down the impellers and interior surfaces. The result is loss of displacement, lowered delivered capacity — and earlier repair or replacement. So, if your cleaning procedure calls for pumping cleaning solution through production lines by means of a Waukesha P.D. Pump, be sure to discharge the solution at the end of the line. *Don't Recirculate It!* What you save on caustics you'll lose many times over in pump repair or loss of efficiency, because just a little dirt turns cleaning into a "grinding" operation that shortens pump life.

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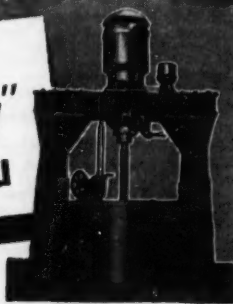
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ADVERTISERS INDEX

For more information about products of these advertisers, use Reader Service postcard in section following

Admiral Tool & Dye Co.	RT409
Air Preheater Corp.	81
Air Products, Inc.	275
Airetool Manufacturing Co.	394
Allen-Bradley Company	32
Allis Co., The Louis.	71-72
Allis-Chalmers Mfg. Co.	45, 95, 103, 345
Allis-Chalmers Mfg. Co., Tractor Division	75
Allmetal Screw Products Co. Inc.	RB407
Amercoat Corp.	135
American Air Filter Company, Inc.	23
American Blower Corp.	91
American Brass Co.	265
American Car & Foundry Co.	14, 141
American District Steam Company, Inc.	40
American Gilsonite Co.	17, 442
American Hard Rubber Co.	273
American Instrument Co. Inc.	RB409
American Locomotive Company	316-317
American Optical Co.	146
American Platinum Works, The	396
American Photocopy Equipment Co.	373
American Sterilizer Company	RT407
American Tool & Machine Co.	393
American Wheelabrator & Equip. Co.	427
Ampco Metals Inc.	234-235
Ansul Chemical Co.	22
Anthracite Equip. Corp.	B420
Appleton Electric Company	20-21
Armco Steel Corporation	277
Armstrong Machine Works	233
Atkomatic Solenoid Electric Valves	L416
Atlas Mineral Products Company	401

Babcock & Wilcox Co.	340-341
Bailey Meter Company	83
Bakelite Company, Division of Union Carbide & Carbon Corp.	E255
Baker & Adamson Products, General Chemical Division	
Allied Chemical & Dye Corp.	157
Baker & Company, Inc.	86, 229
Baker, Perkins Inc.	245
Baldwin-Lima-Hamilton Corp.	78
Barber-Green Company	RT428
Barco Manufacturing Company	389
Bayley Blower Company	395
Bemis Bro. Bag Company	376
Bethlehem Foundry & Machine Co.	27
Bird Machine Company	11
Black, Sivals & Bryson, Inc.	355
Boardman Co. The	382
Bonney Forge & Tool Works	253
Bourne Laboratories	L438
Bridgeport Brass Company	424
Bristol Company, The	306
Brookfield Labs, Inc.	436
Brown Fin Tube Co.	111
Brown & Root, Inc.	119
Buell Engineering Company	279
Buffalo Forge Company	439
Buffalo Meter Co.	398
Buffalo Pumps, Inc.	80
Bufflovak Equip., Blaw Knox Div.	338
Builders Providence, Inc.	319
Bulkley-Dunton Process Inc.	296
Beckman Division, Beckman Instruments, Inc.	459

Cambridge Wire Cloth Co.	M420
Carbide & Carbon Chemicals Co., Div. Union Carbide & Carbon	151
Carpenter Steel Company	35
Cash Company, A. W.	227
Celcote Company	LT428
Celanese Corp of America	94

Century Electric Co.	320-321
Chapman Valve Company	102
Chase Brass & Copper	332
Chemical Construction Corp.	172
Chemical Corporation, The	399
Chemical & Power Products Inc.	369
Chicago Bridge & Iron Company	328
Cleaver-Brooks Company	241
Cochrane Corp.	28
Coddington Mfg. Co., E. D.	381
Commercial Solvents Corp.	153
Continental Can Company	281
Cooper Alloy Foundry Inc.	301
Coppus Engineering Corp.	15
Corning Glass Works	323
C-O-Two Fire Equipment Co.	174
Crane Company	351
Crane Packing Co.	386
Crouse-Hinds Co.	239
Crucible Steel Co. of America	333
Cuno Engineering Corporation	419
Chemsteel Const. Co. Inc.	442
Cleveland Mixer Co.	442

Dampney Co.	387
Darco Dept., Atlas Powder Co.	74
Darling Valve & Manufacturing Co.	44
Darnell Corporation, Ltd.	M422
Davenport Machine & Foundry Co.	436
Day Co., J. H., The	98
DeLaval Separator Co.	219, 283
DeLaval Steam Turbine Co.	160
Deming Company, The	410
Denver Equipment Co.	L420
Dicalite Division of Great Lakes Carbon Corporation	38
Dings Magnetic Separator Co.	147
Dodge Manufacturing Corp.	99
Dorr Co.	263
Durametallic Corp.	LB428
Duriron Company, Inc.	249, 391
Dustex Corporation	L422

Eastern Industries Inc.	388
Eastman Kodak Co.	52
Eclipse Fuel Engineering Co.	377
Elliott Co.	108-109
Enjay Company, Inc.	337
Entoleter Division, The Safety Car & Heating & Lighting Co. Inc.	367

Fansteel Metallurgical Corp.	390
Farrar Birmingham Co., Inc.	16
Farris Engineering Corporation	268-269
Feuwal Inc.	66
Filter Paper Co., The	436
Filtration Engineers, Inc.	314
Flexitall Gasket Co.	350
Flexonics Corp.	175
Flood City Brass & Electric Co.	442
Fluor Corporation	33
Foster Engineering	437
Foster Wheeler Corp.	133
Foxboro Company, The	82
Frick Co., Inc.	404
Friez Instrument Division of Bendix Aviation Corp.	384
Fruehauf Trailer Co.	343
Fuller Company, The	176-177
Fulton Syphon Division, Robertshaw-Fulton Controls Co.	48
Fletcher Works	454

General Amer. Transp. Corp.	121, 237, 271
General Chemical Div. of Allied Chem. & Dye Corp.	113
General Electric Co.	36-37, 47
Gifford-Wood Co.	304

(Continued on Page 456)

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ADVERTISERS' INDEX Continued

Girdler Corp.	2nd Cover
Globe Steel Tubes Co.	90
Glycerine Producers Assoc.	101
Goodrich Chemical Co., B. F.	440
Goodrich Company, B. F., The Industrial Products Division	49, 285
Gotham Instruments Division, American Machine & Metals Inc.	287
Gould National Batteries, Inc.	84
Goulds Pumps Inc.	414
Greer Co., J. W.	412
Grinnell Co. Inc.	8
Griscom-Russell Co., The	297

Haveg Corporation	441
Hapman Conveyors Inc.	402
Hardinge Company, The	L407, 435
Harshaw Chemical Company, The	68
Harnischfeger Corporation	30-31
Hays Corporation, The	29
Helicoid Gage Div. Amer. Chain & Cable Co.	370
Henszey Company	RB423
Hewitt-Robins, Inc.	256-257
Hills-McCanna Co.	408
Hooker Electrochemical Co.	303
Howell Electric Motors Co.	299

Independent Engineering Co., Inc.	L398
Ingersoll-Rand Company	313
International Nickel Co.	335

Jeffrey Manufacturing Co.	65
Jelliff Manufacturing Co., C. O.	RT423
Jerguson Gage & Valve Corp.	R422
Johns Manville Corp., Celite Filter Aids Div.	149
Johns Manville Corp., Packings & Gaskets	291
Joy Manufacturing Co.	69

Kaiser Aluminum & Chem. Sales Inc.	77
Kaiser Engineers Div. of Henry J. Kaiser Co.	R398
Keasbey & Mattison Co.	334
Kelley & Company, O. G.	26
Kemp Mfg. Co., C.	143
Kewanee-Ross Corp.	318
Kidde & Company, Walter	354
Kieley & Mueller, Inc.	266
Klinger Limited, Richard	34
Knight Maurice A.	406
Koppers Company, Inc., Elex Precipitator Div.	392
Koppers Company, Inc., Tar Products Division	57

ADVERTISING STAFF

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Pittsburgh	G. S. Ryan
San Francisco	Ralph Dorland
St. Louis	J. M. Rodger, Jr.

LaBour Company, The.....	309
Ladish Co.....	310-311
Lapp Insulator Company Process Div....	61
Layne & Bowler, Inc.....	223
Lebanon Steel Foundry.....	357
Ledeer Mfg. Co.....	LB430
Lee Metal Products Co. Inc.....	435
Leeds & Northrup Company.....	169
Leslie Company.....	432
Link Belt Co.....	13, 67, 431
Liquidometer Corporation.....	435
Littleford Bros. Inc.....	416
Logan Clay Products Co., The.....	247
Louisville Dryer Div., General American Transportation Corp.....	121
Lubriplate Division—Fiske Brothers Re- fining Co.....	LA09
Lukens Steel Company.....	76
Lunkenheimer Co.....	329
Lawrence Pumps Inc.....	456

Magna Mfg. Co. Inc.....	442
Manning & Lewis Eng. Co.....	455
Manning, Maxwell & Moore, Inc.....	170
Marietta Concrete Corp.....	312
Mark & Company, Clayton.....	383
Marley Co., The.....	9
Master Electric Co., The.....	3rd Cover
Merrick Scale Mfg. Co.....	442
McGraw-Hill Book Co.....	416
McQuay, Inc.....	96-97
Metal Textile Corp.....	403
Meyercord Co., The.....	LT430
Michigan Wheel Co.....	442
Midvale Company, The.....	217
Midwest Piping Co. Inc.....	331
Miller Co., The.....	RB428
Milton Roy Co.....	88
Minneapolis Honeywell Regulator Co.— Industrial Div.....	58-59
Mixing Equipment Co.....	127, 211
Monarch Mfg. Wks., The.....	R425
Monsanto Chemical Co.....	62-63
Murray Mfg. Co., D. J.....	R405

Nash Engineering Company.....	298
National Airoil Burner Co.....	364
National Aluminate Corp.....	380
National Carbon Co. of Union Carbide & Carbon Corp.....	18-19
National Engineering Co.....	53
National Filter Media Corp.....	358
National Foam System, Inc.....	85
National Lead Company.....	129
Neumann & Welchman.....	336
Newport News Shipbuilding and Dry Dock Co.....	344
New York State Dept. of Commerce.....	400
Niagara Alkali Company.....	325
Niagara Blower Company.....	368
Niagara Filter Div. American Machine & Metals Inc.....	213
Nicholson & Co., W. H.....	LB405
Nitrogen Division, Allied Chemical & Dye Corp.....	251
Norton Company.....	92
Nordstrom Valve Division Rockwell Mfg. Co.....	162-163
Norwalk Company.....	356
New England Tank & Tower Co.....	458

Ohio Injector Co.....	50-51
Oilgear Company, The.....	225
Oldbury Electro Chemical Co.....	RB413
Oliver United Filters, Inc.....	429
Omega Machine Co.....	167
Oronite Chemical Company.....	131
Orr & Semblower.....	171

Parker Appliance Company, The.....	158-159
Patterson Foundry & Machine Co.....	139
Patterson-Kelley Company, Inc.....	107
Penberthy Injector Company.....	166
Penfield Mfg. Co.....	438
Pennsylvania Flexible Metallic Tubing Co.....	161

(Continued on Page 458)

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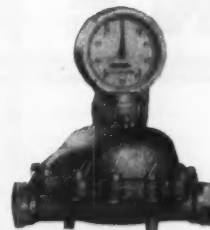
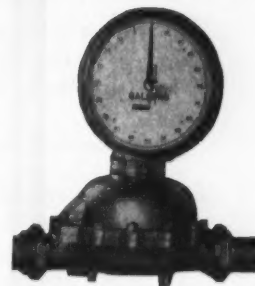
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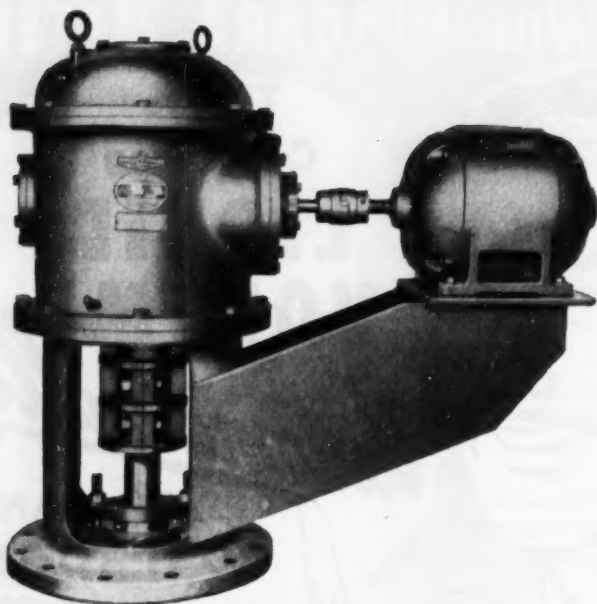
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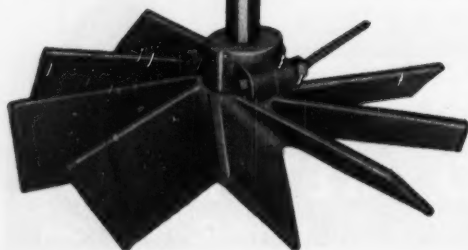
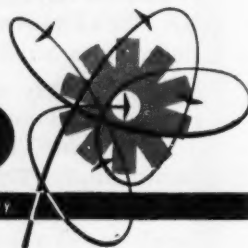
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ADVERTISERS' INDEX Continued

Perkin-Elmer Corp., The.....	261
Permutit Company, The.....	73
Petro-Chem Development Co., Inc.....	123
Pfautler Co.....	93, 4th Cover
Philadelphia Gear Works Inc.....	56
Pittsburgh Coke & Chemical Co.....	137
Pittsburgh Lectrodryer Corp.....	308
Pneumatic Scale Corp. Ltd.....	L423
Powell Valves.....	327
Prater Pulverizer Co.....	374
Pressed Steel Tank Company.....	100
Pritchard & Company.....	293
Pulverizing Machinery Co.....	326
Pittsburg Equitable Meter Division Rockwell Mfg. Co.....	289

Quaker Oats Company, The.....	385
-------------------------------	-----

Raybestos-Manhattan Inc., Rubber Division.....	165
Raymond Pulverizer Division, Combustion Engineering, Inc.....	352
Reichhold Chem. Inc.....	117
Republic Flow Meters Co.....	342
Republic Steel Corp.....	39
Revere Copper & Brass Inc.....	215
Reynolds Metals Company Co.....	79
Rockwell Manufacturing Co.....	289
Rodney Hunt Machine Company.....	221
Roots-Connorsville Blower Corp.....	366
Ross & Son, Company, Charles.....	426
Ryerson & Son Inc., Joseph T.....	182

Saran Lined Pipe Company, Dow Chemical Co.....	360
Schneible Co., Claude B.....	LB415
Schutte & Koerting Co.....	173
Sealot Corp.....	LB411
Sharples Corp.....	125
Shriver & Co., Inc., T.....	LT411
Simpson Mix-Muller Div.....	53
Smith Corporation, A. O.....	24-25
Solvay Process Division, Allied Chemical & Dye Corp.....	155
Sorensen & Co.....	365
Sparkler Mfg. Co.....	375
Spray Engineering Co.....	RT413
Spraying Systems Co.....	LT415
Sprout, Waldron & Co., Inc.....	339
Standard Oil Co. (Indiana).....	41
Stanley Co., Inc., W. W.....	435
Stokes Machine Co., F. J.....	295
Stone & Webster Engineering Corp.....	145
Struthers Wells Corp.....	46
Sturtevant Mill Co.....	179
Sun Shipbuilding & Dry Dock Co.....	434
Superior Combustion Industries.....	R415
Superior Electric Co., The.....	315
Surface Combustion Corp.....	397
Swenson Evaporator Division Whiting Corp.....	6-7

Tennessee Corp.....	413
Taber Pump Co.....	LT405
Tank Storage Terminals Div. of Gen. Amer. Transp. Corp.....	237
Taylor & Co., W. A.....	R411
Taylor Forge & Pipe Works.....	324
Taylor Instrument Co.....	10
Texas Gulf Sulphur Co.....	421
Thayer Scale & Engineering Corp.....	RT426
Thermo Electric Co., Inc.....	372
Titeflex, Inc.....	305
Trane Co., The.....	164
Tranter Mfg. Inc.....	70
Traylor Engineering & Mfg. Co.....	181
Trent Tube Co.....	322
Tri-Clover Machine Co.....	87
Tube Turns Inc.....	417-418
Turbo-Mixer, A Division of Gen. American Transp. Corp.....	271

Union Carbide & Carbon Co.....	151
U. S. Gasket Co.....	363
U. S. Industrial Chem. Co.....	243-244
U. S. Rubber Co.....	330

United States Steel Corp., Stainless Steel	42-43
U. S. Stoneware	104

Vantow Pump Corp.	371
Viking Pump Co.	RB426
Vilter Manufacturing Company	378
Vogt Machine Co., Henry	180
Vulcan Iron Works	302

Waukesha Foundry Co.	454
Wagner Electric Corp.	60
Walworth Co., The	433
Welding Fittings Corp.	259
Welsbach Corp., The	64
Western States Machine Co.	359
Westinghouse Elec. Corp., Sturtevant Div.	89
Weston Electrical Instrument Corp.	224
Wiedeke Co., Gustav, The	LB425
Willfley & Sons, A. R.	168
Williams & Co., C. K.	361
Williams Patent Crusher & Pulverizer Co.	54
Wilson Inc., Thomas C.	379
Wolverine Tube Div.	178
Worthington Corp.	300, 307
Wyandotte Chemicals Corp.	55

Yarnell-Waring Co.	12, LT425
Youngstown Welding & Engrg Co.	362

Zirconium Corporation	231
-----------------------	-----

SEARCHLIGHT SECTION (Classified Advertising) H. E. Hilty, Mgr.

EMPLOYMENT	
Positions Vacant	444
Selling Opportunities Offered	444
Positions Wanted	444
Selling Opportunities Wanted	444
Employment Services	444

BUSINESS OPPORTUNITIES	
Offered	444

EQUIPMENT	
(Used or Surplus New)	
For Sale	444-453

WANTED	
Equipment	452

ADVERTISERS INDEX

A. C. Tank Co.	450
Aaron Equipment Co.	448
Albert Pipe Supply Co., Inc.	451
American Air Compressor Corp.	446
Barcan Co., Irving	448
Brill Equipment Co.	447
Chemical & Process Machinery Corp.	451
Chemical Service Corp.	452
Consolidated Products Co., Inc.	445
Cowden Machinery Co., W. C.	450
Electric Equipment Co.	450
Employment Counsel Inc.	444
Equipment Clearing House Inc.	451
First Machinery Corp.	443
Gelb & Son Inc., R.	452
Heat & Power Co., Inc.	452
Heineken Inc., W. P.	450
Kehoe Machinery Corp.	452
Lawler Co.	452
Leston Corp.	452
Liquid Carbonic Corp.	444
Loeb Equipment Supply Co.	448
Loeb & Son, H.	450
Luria Steel & Trading Corp.	
Erman-Howell Division	452
Machinery & Equipment Corp., N. Y.	450
Machinery & Equipment Co., (Calif.)	451
Meyer & Sons Inc., Wm. W.	450
Nutrillite Products, Inc.	452
Perry Equipment Corp.	449
Process Machinery Supply Co.	450
Process Plants Service Inc.	452
Reynolds, Gerald B.	444
Stanhope Inc., R. C.	450
Stein Equipment Co.	446
Strickler & Assoc., Dean C.	448
Truland Chemical & Engineering Co.	444
Union Standard Equipment Co.	446
Vulcan Detinning Co.	452

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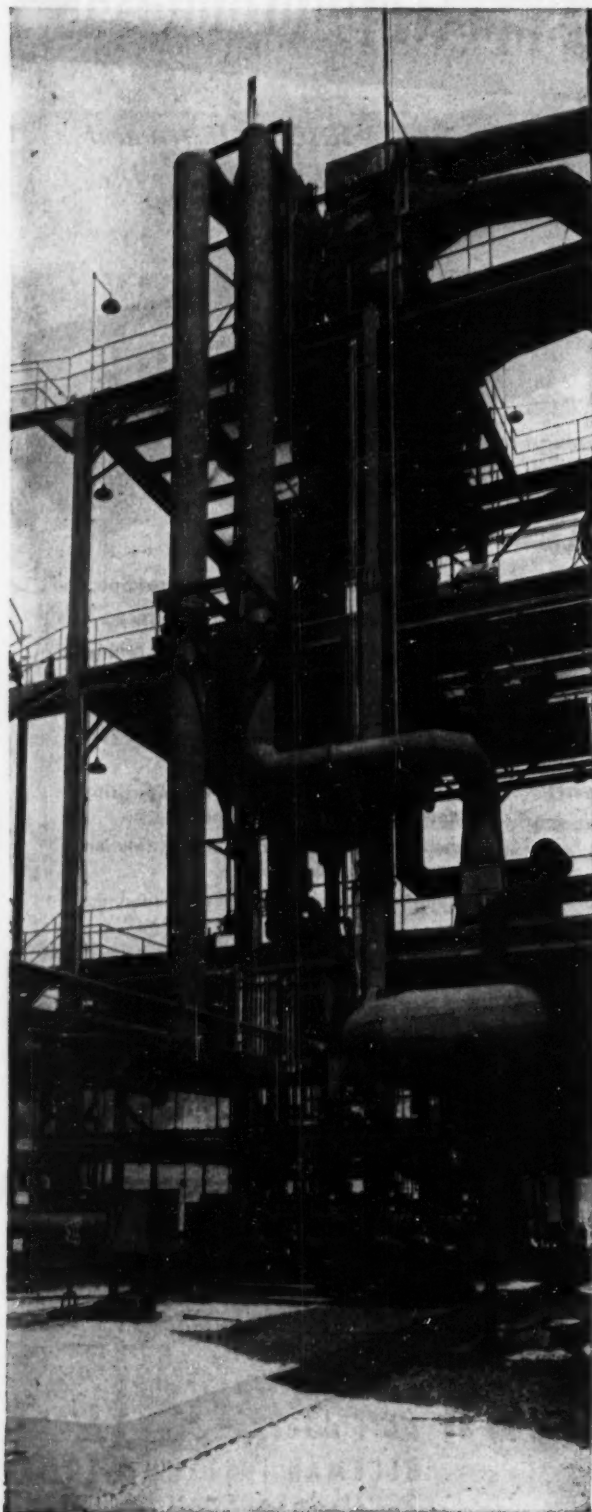
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• CHEMICALS

• EQUIPMENT

• SERVICES

• TECHNICAL LITERATURE

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• CHEMICALS

Acids, dichloroacetic	464A
Activators, rubber	150C
Alcohol, synthetic ethyl	243-4a
Alcohols, fatty	464B
Alubragum	464C
Alumina tri-hydrates, organic free	79
Aluminas	77
Aluminizer	154A
Amines, unsaturated secondary	156C
Ammonia	243-4b
Anhydride, maleic	117
Benzoic acid, bulletin "Dacron" dyeing	bklt
Buna N	156G
Calcium carbonate	55
Carbon black	156I
Carbons, activated	74
Catalysts	
Platinum & palladium	396b
Rhodium	229
Cellulose derivatives	150A
Coal chemicals	137
Dianisidine diisocyanate	62-3b
Diisobutyl ketone vapors	464D
Electro-chemicals	BR413
Emulsion tackifiers	156H
Ethyl alcohol	464E
Filter aids, diatomaceous	38
Fine chemicals	157
Fluorides	68
Furfural, bulletin 201-A	385
Galvanizers	152C
Gelling Agents	464F
Glycerine	101
Herbicides	150E
Hydrogen peroxide handling	464G
Indelible colored inks	156E
Ion exchangers	73a
Lubricants, viscous	41
2-Mercaptobenzimidazole	62-3c
Methanol	94
Methylamines, data sheet 12	153
Methylene chloride	464H
α -Methylstyrene Dimers	156F
o-Nitrochlorobenzene, bulletin ONCB	62-3c
Oils	
Sperm	464I
Tall	464J
Ozone	64b
Paint, anti-rust	152A
Petroleum chemicals	337
Phenyl ethanolamines	464K
Pigments, iron oxide	361
Plasticizers	464L
For PVC	154E
For Vinyls	150B
Plastics, molding	464M
Plastics & resins	464N
Polyvinyl chloride	464O
Propylene glycol	151
Resin raw material	154B
Resins	464P
High styrene butadiene formulations,	
Bulletin P-149	62-3h
Ion exchange	380

Molding	152B
Paint formulating, masonry, bulletin	
P-126	62-3g
Phenolic	154C
Polyvinyl	440b
Preprocessed	154D
Rubber-like	148A
Safety solvent	156A
Sequestrants, organic	150D
Sheeting & film, acetate	464Q
Silicates	464R
Silicone release agents	464S
Silicone spray	152E
Sodium dispersions	464T
Sodium nitrate	155
Sodium sulfhydrylate, bulletin 100	303b
Sodium sulfides, bulletin 100	303a
Sodium tetra-sulfide, bulletin 100	303c
Stabilizers, vinyl	464U
Sulfonation	131
Sulphur dioxide	L413
Textile water repellent	156B
Thioglycolate ester	156D
Trichlorethylene	325
Triethyl thiono-phosphate	62-3f
Trimethylolthane	465A
Varnishes & resins	465B
Vermiculite	465C
4-Vinylpyridine	152D
Water repellents	465D
Wetting Agents	62-3a
Zirconium oxide, stabilized	231

• EQUIPMENT

Absorbers, HCl	18-9e
Accelerometers	466N
Actuators, valve, bulletin 3000	BL430
Agitators	458
Air conditioning equipment	96-7b, 378
Air handling equipment	91, 439
Alloys	
Aluminum-bronze	234-5
Nickel	335
Analizers	83b
Anodes, graphite for electrolytic processes	18-9h
Apparel, acid & oil resistant	146
Bags, flexible & waterproof	376
Batteries	84
Bellows, precision	305b
Belting	
Conveyor	256-7a
Rubber	468J
Elevator	256-7b
Transmission	256-7d
Belts	165b
Conveyor	
Rubber	285
Woven wire	M420
Blenders	
Dry	286A
Twin-shell, catalog 12	107
Blow rings, dust tube	290A
Blowers	
Axial	282B
Blowers & exhausters	
Centrifugal	366b
Rotary positive	366a
Vaneaxial	466D

Boilers	469M
Automatic, packaged, bulletin 1219	171
Steam & hot water, catalog AD-100	241
Two-drum	188b
Calculators, valve size	470I
Cameras, roll film	472E
Car shakeouts	256-7h
Casters and wheels	M422
Castings & fittings, lead bonded	26e
Castings, steel	357
Cells, load	272C
Cements, vinyl resin	468E
Centrifugals	245c, 393, B454
Automatic electric drive	359
Continuous	286E, 465E
Centrifuges	219
Bulletin 1248	125
Chains, roller, data book 2457	67
Chambers, vacuum pressure	TR407
Circuits, thermocouple	274A
Cladding, platinum, Bklt. 96	86
Cleaners, tube	394b
Bulletin 1046	379
Coatings	
Neoprene	276D
Protective	486F
Bituminous	57
Form 253	468G
Metals	387
Stonelike corrosion-proof	TL428
Tank	276E
Cocks	34b
Coils	
Lead	26b
Plate-type	282E
Columns, fractionating	323c
Combustion chambers, HCl	18-19d
Combustion control, bulletin SA 11-50	466O
Compressors	290D, R411
Air & gas	345
Centrifugal, air	466E
Centrifugal recycle	466F
Heavy duty	313
High pressure	356
Recirculator, high-pressure	300
Computers	466P
Condensers, refrigeration, bulletin RC-2	469N
Condensers, tower	316-7c
Connectors, electrical	305e
Contractors, centrifugal	284A
Control systems, bulletin 98097	10
Controllers	83c
Pneumatic	169
Potentiometer pyrometer type,	
bulletin 50-4, 55-E	372a
Resistance thermometer type,	
bulletin 55-E, 50-E	372b
Controls	
Bulletin G-537	467A
Motor	32b
Motors, high voltage, bulletin GEA-5409	47
Liquid level, Pub. #53-766-38	29
Temperature	66
Conveying equipment	
Catalog 852	65b
Catalog GC-53	468K
Conveying systems	
Air	326
Belt	431
Conveyors	
Air	176-7, 339a
Belt	339c, TR428
Bulk-flt, book 2475	13
Engineered	256-7f
Granular bulk material	304
Multi-tier	412
Screw	339b
Sectional	256-7
Tubular, bulletin CE-254	402
Coolers	121
Air	316-7b
Cascade	18-9c
Bulletin PE-8	323b
Centrifugal	282F
Rotary water tube	TR436e
Sample, boiler water, bulletin 110	469O
Cooling systems	404
Copper & copper alloys	424

Impervious graphite	18-9b	Indicating, bulletin 60-E	372c	Thermocouple protection, bulletin P1261	468D
Pipe, fittings & valves	360	Miniature	272A	Tubing	362
Pipe, seamless & welded	471B	Multi-point	274B	Metallic, flexible	161
Pipes, drain channel, clay	247	Rectifiers, mechanical	278D	Stainless & high alloy	322
Piping	331	Reducers, speed	99, 469H, 469I	Stainless steel	35
Plastic	330a	Refrigeration equipment	96-7c	Turbines, single stage, bulletin 4206	160
Plastics	468H	Regulators		Unions, stainless steel	383
Rigid vinyl, corrosion-resistant	440a	Automatic voltage, bulletin S351	315	Valve operators, two-speed	56
Plasticizers	62-3i	Temperature	268-9a	Valve prices	471D
Platecoils, bulletin P61	70	Voltage control	365	Valve size calculators	266b
Plates, condenser, copper alloy	215a	Reproduction materials	52	Valves	34d, 50-1a, 227, 471E, 471F
Platinum, gold & silver products, catalog C-20	396a	Roof decks	468I	Air, wobble-rod	471G
Porcelain processing equipment	61	Rubber equipment	292C	Angle, corrosion-resistant, bulletin HR	371c
Porcelain products, chemical	471C	Rubber and plastic equipment	273	Angle, weld	170b
Positioners, hydraulic	268-9b	Rubber processes	466A	Automatic shut-off	471H
Powder filling equipment, vacuum	1A23	Rubber, sure footed	280A	Bronze	50-1b
Precipitators	465N	Scales		Cast steel	50-1d
Electrostatic, gas cleaning	392	Automatic bagging, bulletin 0552	469A	Catalog 10	102
Preheaters, air	81	Filling	TR426	Chemical service	391
Presses		Scalers, pipe thread	278C	Control, molded diaphragm, bulletin CV53	266a
Filter, catalog 52	TL411a	Screens	256-7i	Electro-hydraulic	471I
Plastics molding	465O	Vibrating	1A20b	Electric, solenoid	471J
Presses & screens, dewatering	TR436a	Seals		Gate	351
Process equipment	340-1	Elastic piston	268-9c	Gate & check, rubber lined iron body	44
Process plants & equipment	2	for agitators & mixers	BL411	Globe, corrosion-resistant, bulletin HR	371b
Processing & synthesizing units	139	Separators		Globe, weld	170a
Production equipment, heavy	344	Air, mechanical	54	Iron	50-1e
Propellers	TL442	Centrifugal, continuous	466B	Lead & lead lined	26c
Proportioners, foam	280D	Mist elimination	403	Lubricant plug, bulletin V-217	162-3
Pulleys, cast iron, catalog 852	65a	Water treatment	296	Lubricated plug	50-1f
Pumping & heating equipment, fuel oil, bulletin 40	466K	Shafting, flexible, bulletin 525	469J		
Pumps		Sheeting, protective, rubber	276A		
Bulletin P/1	249	Shelters, loading dock	469B		
Catalog UP-52R	408a	Shielding, ignition	305d		
Acid	168b	Sifters, circle	45c		
Centrifugal	292B, 466I, 466J	Silica, opaque	276C		
Catalog S-7250	18-9a	Stackers	256-7o		
Catalog 253	87	Starters, motor, bulletin 712	32a		
Chemical, bulletin 725.3	414	Steel			
Corrosion-resistant		Aluminized	277		
Bulletin W-350-B14	307	Glassed	476		
Bulletin HR	371a	Stainless	39, 333		
Self-priming	309	Steels	182		
Chemical		Clad	76		
Proportioning, bulletin 4061-A	B409	Storage systems & silos	312		
Self-priming	336	Strainers, fine screen, bulletin S-203	TL425		
Split-shell, bulletin 982	80	Switchboard instruments, bulletin GEC-218C	468A		
Close-coupled, bulletins 52B6083, 52B6140	95a	Tanks			
Controlled volume, air powered, bulletin 1053	88	Lead bonded	26a		
Diaphragm	290B	Resin bonded, glass laminated	399		
Fine abrasives & corrosives handling, bulletin 52B6615	95d	Steel	141		
Frame-mounted, bulletins 52B6351, 52B6105	95f	Tantalum	390		
Fuel oil	466K	Thermometers	58-9b		
Hermetically sealed	288A	All metal	224		
Hydraulic	466L	Dial, multi-angle	287		
Jacketed unit, catalog UP-52R	408c	Tower packings	286C		
Jet	166b	Towers	18-9g		
Liquid oxygen, bulletin 203-6	456	Cooling	33		
Multi-stage, bulletin 52B6105	95b	Bulletin R-52-P10	9		
Plastic	292E	Tractor shovels	75		
Plunger, gathering type	BL442	Trailers, tank	343		
Proportioning	290C	Transformers, instrument, bulletin GEA-4626G	468B		
Refinery type, bulletin 52B7775	95c	Transmissions, fluid power	225b		
Rotary, bulletin 54SC	BR426	Transmitters, bulletin A-707-A	468C		
Sand	168a	Pneumatic	274C		
Sanitary, positive displacement	T454	Data Book 1004	342		
Slurries & pulps handling, bulletins 52B7112(PW), 52B6381(CW)	95e	Thermometer	274D		
Standard feed, catalog UP-52R	405b	Traps			
Sump, automatic electric	166a	Steam, catalog J	233		
Variable speed unit, catalog UP-52R	408d	Freeze-proof, bulletin 853	BL405		
Vertical, steam jacketed, bulletin V-837	TL405	Impulse, bulletin T-1740	12		
Vertical turbine	223c, 466M	Trippers	256-7g		
Bulletin 4700-51	410	Truck attachments, fork	469C		
Recorder-controllers, multi-point	467J	Trucks			
Recorders	306	Fork	469D		
Analog data	272B	Lift, Form 1284	469E		
		Tubes			
		Condenser	178		
		Copper & brass	215b		
		Copper, publication C-24	265		
		Heat exchanger	332		
		Rotary steam	TR436b		

• SERVICES

Design and construction, chemical plants	293
Design and construction, fertilizer plants	172
Engineering & construction	119, R398, 470C
Process plants	145
Hygiene, industrial	470D
Low temperature processes	275
Medicine, industrial	470E
Plant location	400
Plant process equipment	470F
Polymer directory	470G
Storage & transportation, bulk liquid	237
Surveys, company business	470H

Technical Literature Now Available . . .

For quick replies to your requests for any of the literature mentioned in this section, note the key numbers for the items desired and circle them on the handy, postage free reply cards located adjacent to the back cover.

Chemicals

Acid, Anhydrous, Hydrofluoric 68	40 p. book contains valuable information on hydrofluoric acid anhydrous. Provides helpful data for those who now use HF, or for those contemplating its use. Harshaw Chemical Co.
Acid, Dichloroacetic 464A	Technical data on dichloroacetic acid and dichloroacetyl chloride. Covers specifications, properties, applications and resume of past experimental work. Kay-Fries Chemicals.
Alcohols, Fatty 464B	Covers chemical structure & composition, reactions, applications, & solubility data on complete company line of fatty alcohols. Technical Bulletin 903-A. Archer-Daniels-Midland.
Alubragum 464C	Describes the Alubragums (sodium and potassium polyacrylates) and their applications as specialized latex thickeners for the latex and paint industry. W. H. & F. Jordan, Jr., Mfg.
Catalysts, Rhodium 229	Simplify catalytic processing & effect savings for chemical & pharmaceutical manufacturers. Covers notes on their uses & a list of their most available forms. Baker & Co., Inc.
Chemicals, Fine 187	Offers Data Sheets on many high purity process chemicals. Includes information on pertinent physical and chemical properties, suggested uses, containers, etc. Baker & Adamson.
Dianisidine Diisocyanate 62-3b	Part of Monsanto's family of isocyanates now being used in such applications as adhesives, polyester rubber, foamed-in-place resins, etc. Technical Data Sheet. Monsanto Chemical Co.
Diisobutyl Ketone Vapors 464D	Presents publication, "Toxicity & Hazard of Diisobutyl Ketone Vapors." Data on chemical properties, experimental procedure & results. Mellon Institute of Industrial Research.
Dyeing, Dacron 62-3d	Benzoic acid offers numerous applications and one of its most recent applications is as a carrier in the dyeing of "Dacron," polyester fiber. Bulletin available. Monsanto Chem. Co.
Ethyl Alcohol 464E	Covers description, specifications, physical properties, grades & types, toxicity, government regulations, shipping, handling & storage, etc. TDS 21. Commercial Solvents Corp.
Forfural 385	Covers its derivatives & associated products. Includes practical information on commercial handling, physical data, chemical reactions, uses, etc. Bulletin 201-A. Quaker Oats Co.
Galvanisation, Cold 185C	Data on the process of cold galvanization by brush, spray or dip method. Includes fields of application, methods of application, advantages and specifications. Galvicon Corp.
Gelling Agents 464F	Find new application in rapidly growing field of vinyl plastisols & organosols. Also particularly suitable for production of plastigels. Technical Service Bulletin G-5. Witco Chem.
Glycerine 101	Possesses numerous properties which make it preferable for toilet preparations. Safe for use in pharmaceuticals. Covers range of properties & applications. Glycerine Producers'.
Hydrogen Peroxide Handling 464G	Includes study of heat balance in hydrogen peroxide storage vessels & recommendations on the handling & storage of material. Charts & graphs in Bulletin 54. Buffalo Electro-Chem. Co.
2-Mercapto-benzimidazole 62-3e	Compound is soluble in alcohol, ethyl acetate and acetone. It is insoluble in other common organic solvents and has a melting point of 295-300°C. Data Sheet. Monsanto Chemical Co.
Methylamines 183	Represent most economical source of amine group due to their low equivalent wts. and moderate cost. Many uses, specifications, properties, etc. in TDS 12. Commercial Solvents Corp.
Methylene Chloride 464-H	Covers physical properties, solubility in various liquids, azeotrope formation, handling & storage, toxicity, shipping, uses, reactions. Product Development Bulletin CM-1. Solvay.

o-Nitrochlorobenzene 62-3c	Offers wide number of uses. Noted for its versatility and high reactivity in the production of many derivatives which serve as intermediates. ONCB Bulletin. Monsanto Chemical Co.
Oil, Sperm 464I	Sperm oil & sperm oil products. Data on characteristics, chemical & physical properties, composition of 12 oils & waxes, solubility, etc. Bulletin 94A. Archer-Daniels-Midland.
Oil, Tall 464J	Covers methods of refining & testing tall oils & offers information on materials for storage & processing equipment. Also industrial applications. Bulletin C-53. K. A. Steel Chem.
Paint Formulating, Masonry 62-3g	Bulletin P-126, "Arociors in Formulating High Styrene-butadiene Copolymer Surface Coatings (Filolite S-5 Resins)." Includes properties and characteristics. Monsanto Chemical Co.
Phenyl Ethanolamines 464K	Data on phenyl ethanolamine, phenyl diethanolamine, phenyl methyl ethanolamine and phenyl ethyl ethanolamine. Uses, properties, shipping data, etc. Bulletin F-8280. Carbide & Carbon.
Pigments, Iron Oxide 361	Reduce grinding and dispersing time in paints and allied products as much as 75%. Physical & chemical specifications and suggested applications. VVF Tech Report. C. K. Williams & Co.
Plasticizers 464L	26 p. explains why and how plasticizer can be used profitably in polyvinyl acetate emulsion adhesives. Bulletin includes 8 tables which offer pertinent test data. Atlas Powder Co.
Plastics, Molding 464M	Describes acetate molding materials available in 6 different formulation series compounded to meet a range of ASTM flow characteristics. Illustrated, 16 p. Celanese Corp. of America.
Plastics, & Resins 464N	Latest information about more than 50 Bakelite & Vinylite plastics & resins, their properties & uses. Contains 80 photographs showing applications & finished products. Bakelite Co.
Polyvinyl Chloride 464O	Describes series of polyvinyl chloride resins manufactured & the applications of each type. Includes graphs & tables on various properties of the material. Dow Chemical Co.
Resin Raw Materials 154H	Experimental product for applications where urea or melamine are now used. Covers suggested applications, properties, handling & storage, etc. Bulletin PD-B-1. Nitrogen Division.
Resins 464P	Describes use of casting resins for encapsulation embedment of electronic components and circuit assemblies. Offered in number of formulations. 14 p. Brochure. Aries Labs.
Sheeting & Film, Acetate 464Q	High quality thermoplastic materials made from cellulose acetate in a wide range of widths, lengths, thicknesses, formulations. Includes properties, applications, etc. Celanese Corp.
Silicates 464R	Have wide range of physical and chemical properties. Covers use in sealing porous castings, cast metal molding, investment casting cements, etc. in 6 p. Folder. Philadelphia Quartz.
Silicone Release Agents 464S	Valuable aids in reducing number of rejected parts molded from numerous types of organic plastic resins. Includes information on applications in Data Sheet 5-104. Dow Corning.
Sodium Dispersions 464T	Techniques for preparation, diagrams of equipment used in preparation, applications, dispersion formulations with tables, etc. in 30 p. booklet. U. S. Industrial Chemicals Co.
Sodium Sulfides 303a	Quick-dissolving sodium sulfides give clear solutions—free of sediment—in 15 minutes. Data Sheets available. Bulletin 100 covers products & services. Hooker Electrochem.
Stabilizers, Vinyl 464U	New lead compound developed for the stabilization of halogen containing organic materials. Covers data on uses, composition, appearance, solubility, etc. Witco Chemical Co.
Tackifiers, Resin Emulsion 156H	Designed to produce fast-breaking (fast-setting) adhesives. Typical applications—side lasting & sock lining cements in shoe industry, carton adhesives, etc. American Resinous Chemicals.
Triethyl Thiono-phosphate 62-3f	Data Sheet offered for this clear, colorless to straw-colored liquid. Contains information pertaining to molecular weight, formula, approximate properties, etc. Monsanto Chem. Co.

Trimethylethane 465A	Covers new uses of trimethylethane as a raw material in manufacture of alkyls, high-grade drying oils, plasticizers, surface active agents and fine chemicals. Heyden Chemical.
Varnishes & Resins 465B	Concise comparison of properties & performance of leading silicone electrical insulating resins. Curves show thermal life of varnishes & resins. Data Sheet 10-227. Dow Corning Corp.
Vermiculite 465C	Includes information on solubility, density, thermal properties, surface area, availability, typical chemical and physical uses, etc. in Technical Data Manual. Zonolite Co.
Water Repellents 465D	Blends of waxes, textile resins, organic, heavy metal compounds for use in dry cleaning industry. Covers properties, application, shipping. Data Sheet E-118. American Resinous Chem.
Wetting agents 62-3a	Literature available on Sterox AJ as used in superphosphates. Users get product that cures rapidly & is free of hard, troublesome lumps. Suitability & features. Monsanto Chemical Co.
Zirconium Oxide, Stabilized 231	Finds successful usage in refractory, ceramic, electrical & abrasive fields. Covers chemical & physical properties & suggested uses in new descriptive folder. Zirconium Corp.

Process Equipment

Blenders, Twin Shell 107	More thorough blending in fraction of the time previously taken. One blender replaces methods which required a separate drum for every mix. Offers Catalog 12. Patterson-Kelley Co.
Centrifugals 393	High speed centrifugals reduce crystal moisture to 1%. Includes data on separation, extraction, dehydration, clarification, filtration, draining, etc. Illustrated. American Tool & Mach.
Centrifugals, Continuous 465E	Offer features for maximum flexibility. Includes hydraulic-mechanical combination drive with hand wheel control. Specifications in Illustrated Bulletin TC-10-53. Tolhurst Centrifugals.
Centrifuges 125	Tubular bowl centrifuges with full flow stream design which assures continuous maximum efficiency & throughput. Removal of solids is easy & quick. Bulletin 1248. Sharpies Corp.
Crushers, Rotary Fine 179	Crush or granulate to fine, even sizes without excess dust. Speed output of fines, cut reduction costs. In output capacities from 1 to 30 tons-per-hr. Offers Catalog. Sturtevant Mill.
Discs, Rupture, Safety Head 355	Developed for low pressure applications of a type, which, because of extreme corrosive conditions, cannot be handled by the standard pre-bulged type of disc. Black, Sivalis & Bryson.
Dust Collectors 23	Information on hydro-static precipitators for rotary kiln service. Offer high collection efficiency on even small micron particle sizes. Bulletin No. 277. American Air Filter Co.
Dust Collectors 465F	Discusses problem of dust collection in food and processing industries and advantages of company line of dust collectors. 8 p. Illustrated Bulletin 171. Green Fuel Economizer.
Dust Collectors 427	Feature high efficiency, economical operation, dependable performance, economy of space required for installation. Applications in 18 industries in 28 p. American Wheelabrator.
Dust Collectors BL415	Specialists in dust, fume and odor control equipment offer wet method dust collectors that wash dust, fumes, etc. out of the air. Offers Analysis Book. Claude B. Schneible Co.
Dust Control L422	Valuable information relating to scope of dust problem or collection equipment requirements found in new manual, "A Simplified Test Method for Dust Control Determination." Dustex Corp.
Dust Recovery 279a	New profits in terms of tons of valuable dust that can be returned to production rather than wasted in the air. Brochure explains 3 systems of industrial dust recovery. Buell Engrg. Co.
Eliminators, Mist 463	Effectively & economically control liquid entrainment resulting from processing operations which involve handling of liquids & gases together. Offers Catalog. Metal Textile Corp.
Evaporators 221	Turbulent thin film principle evaporates Time-at-Temperature sensitive materials in seconds. Available in ranges from 40 to 2500 lb./hr. of water evaporation. Rodney Hunt Machine Co.
Extractors, Mix-&-Settle 465G	For petroleum, pharmaceutical, chemical, petrochemical & fine chemical industries. Includes design principles, operation, features, cross sections, photos, etc. National Research Corp.
Feeders, Fluidized 465H	Make possible the feeding of fluidized beds of solids in dense phase through pipes in the same manner as liquids. Features increased production at lower cost. Sawyer-Bailey Corp.

Filters, Horizontal Leaf 465I	Feature higher feed rates, elimination of cake erosion, uniformly porous cakes, equally distributed internal feed, lower air-blown cake residues & losses, etc. Process Filters.
Filters, Pressure Leaf 213	For flow rates 2 to 5 times greater than cloth covered presses; positive removal of all suspended solids to desired degree of clarity; etc. Catalog NC-1-53. Niagara Filters Div.
Filters, Rotary Vacuum 314	String Discharge handles almost any type of cake . . . thin, soupy slimes . . . heavy or coarse granular materials . . . or sticky gels. Details in Technical Bulletin 103. Filtration Engrs.
Fractionating Columns 323c	Offer advantages in solving fractionating and absorption problems. No corrosion, no contamination. Available in 4" and 6" sizes with any number of plates. Data Sheets. Corning Glass.
Generators, Inert Gas 143	Cost-saving generators assure safe, dependable supply of chemically clean inerts. Deliver inerts at a special analysis . . . without fluctuations. Bulletin 1-10. C. M. Kemp Mfg. Co.
Ion Exchange 465J	Outlines ion exchange technology and industry uses. Fundamental ion exchange processes described with aid of detailed drawings. Covers many applications. 14 p. Rohm & Haas Co.
Jet Apparatus 173	Can be used to measure and mix in continuous operation, cool and concentrate in continuous application, pump and heat in continuous process, etc. Bulletin SK-1. Schutte & Koerting.
Kettles BR435	Available for every processing need. Descriptive bulletins with data on kettles where corrosion-resistant equipment is needed. All kettles are made to A.S.M.E. code. Lee Metal Products.
Kettles 465K	Photos, engineering drawings, charts, tables & graphs cover line of agitated kettles. Available in metals ranging from aluminum to stainless steel. Colonial Iron Works Co.
Kilns, Rotary 392	Contains data on rotary kilns for lime plants, cement plants and other modern applications. Feature efficient, economical operation. 28 p. Illustrated Bulletin A-442. Vulcan Iron Wks.
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Low-Temperature Processing 275	36 p. brochure on low-temperature processing of gases, liquids, and solids. Describes the broad opportunities—illustrates present and probable applications. Air Products, Inc.
Mills, Grinding 181	For wet or dry, coarse or fine grinding. Assures a uniform product of desired fineness. Improved design and construction features in Bulletin 8121. Traylor Engineering & Mfg. Co.
Mills, Grinding TL435	Dry, grind and classify—in a single system—materials carrying an appreciable amount of surface moisture, reducing them to dry, finely ground products. Bulletin 17-B-11. Hardinge.
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Mixers 388	Mixers meet tremendous variety of fluid mixing needs. Includes data on side entering mixers, top entering mixers, turbine mixers, etc. in Fluid Mixing Catalogs. Eastern Industries.
Mixers, Banbury 16	Illustrated, 32 p. with data on recent design advancements. Includes heavy-duty, "Uni-drive" machine developed for high-pressure, short-cycle mixing. Bulletin 198. Farrel-Birmingham.
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Precipitators 465N	Efficiently remove impurities from liquid by precipitation, adsorption, settling, filtration. Covers applications, operation, design, advantages, etc. Bulletin 2204B. Permutit Co.
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Technical Literature, (cont'd.)

Processing Apparatus 2	32 p. describes various continuous processing systems. High rate of heat transfer affords advantages for heating, crystallizing, controlling heat of reaction, etc. Girdler Co.
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Rubber Processes 466A	Includes a composite of text material on general rubber processes. Data sheets provide complete specifications on equipment for the rubber industry. Explains applications. J. H. Day.
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Pumps, Blowers, Compressors

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Fans, Adjustable-Pitch 466H	For cooling tower, heat exchanger & mine service. Specifications plus performance figures for fans frequently used in mine installations. Bulletin A-111. Hartzell Propeller Fan.
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Gages, Welding Pad R422	Built to be welded directly onto a still, tank, vessel, etc. Covers reflex & transparent types. Includes design materials & construction. Cross section drawings. Jerguson Gage & Valve.
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Instruments 467E	Feature instruments and accessories for the detection and measurement of radioactivity. Covers data on scaling instruments, counting rate meters, etc. Illustrated. El-Tronics.
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Instruments, Indicating 467F	Information on portable d-c indicating instruments. Covers applications, performance data, features, specifications, prices, etc. Illustrated Bulletin GEC-979A. General Electric.
Meters 280	Ideal for measuring liquids entering into foods and pharmaceuticals—also chemicals and corrosive liquids. Construction of stainless steel. Bulletin OG-403. Rockwell Manufacturing Co.
Meters, 29	Measure, indicate and total flow of corrosive and hard-to-meter liquids without the use of weigh tanks, orifice plates, or gage sticks. Details in Pub. No. 53-766-38. Hays Corp.
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Pendulums, Ballistic 467I	Features precision calibration, wide acceleration range, clean shock pulses, automatic or manual operation, etc. Includes specifications in illustrated Bulletin AT-2. Gulton Mfg.
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Thermometers 224	Solve temperature checking problems and reduce thermometer costs. Feature multiple helix for better accuracy & all-metal construction for longer life. Weston Elec. Instrument Corp.
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Transmitters 468C	Features & operation of differential pressure primary element transmitter. Illustrated with hook-up & schematic diagrams, phantom-cutaway views, etc. Bulletin A-707-A. Swartwout Co.
Transmitters, Pneumatic 343	36 p. cover transmitters for measuring flow, pressure, level, density. Offer longer life, less maintenance, continuous, accurate operation. Data Book 1004. Republic Flow Meters.
Tubes, Thermocouple Protection 468D	Covers properties & specifications & describes metal-ceramic thermocouple well—resistant to both air oxidation & combustion gases at high temperatures. Bulletin P1261. Bristol Co.
Weighing Devices 78	For measuring load, fluid pressure, or torque more accurately and economically. Offers Booklet No. 4106 on tank weighing and Booklet No. 4105 on crane scales. Baldwin-Lima-Hamilton.

Construction Materials

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Coatings, Protective 468F	Check list of metal protective & paint bonding chemicals & processes. Data on protective coating chemicals for paint-bonding on steel, zinc, aluminum, etc. American Chemical Paint.
Coatings, Protective 468G	Presents valuable treatise on rust prevention. Features 94 color chips of Rust-Oleum products and instructions for surface preparation and application. 20 p. Form 253. Rust-Oleum.
Coatings, Protective 57	Specially formulated from coal-tar pitch base. Stop corrosion caused by moisture—acid fumes—alkaline fumes—corrosive soil—salt air—heat. Offers set of booklets. Koppers Co.
Fabrication, Alloy Metals 416	Fabricates such metals as stainless steel, monel, everdur, nickel, inconel, herculoy and aluminum into hundreds of products used by the process industries. Littleford Bros., Inc.
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Lead Products 175	For efficient control of corrosives. Provides all common mill shapes, sizes and forms . . . sheet, pipe, fittings, valves. New booklet on "Chemical Lead Products." National Lead Co.

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Handling & Packaging

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Materials Handling 468N	Integral-type Motocylinders for material-handling applications. Includes operational and maintenance features plus ratings and characteristics in Booklet B-6090. Westinghouse.
Materials Handling 4680	Data on new combined tractor-trailer & towline order picking system for warehouses, 50 models of floor trucks, 12 types of dollies, etc. in illustrated Junior Catalog 54G. Nutting.
Packers, Bag 381	Cut packing costs—quickly fill self-closing bags to desired weight, save time in filling, eliminate need for sewing or other expensive bag closing equipment. E. D. Coddington Mfg.

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Shelters, Loading Dock 469B Offers 20 p. illustrated booklet "Your Guide To Important Facts About Loading Dock Shelters & Canvas Wall Curtains." Covers various types of each product & their use. Atlas Industries.

Silos & Storage Systems 312 Concrete silos & storage systems meet needs of diversified industries. Improve handling facilities, help build reserves, lower operating costs, etc. Offer Catalog. Marietta Concrete.

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Packings, Teflon, Braided 386 For valves in corrosive service. Teflon recommended on chemicals at any pressure with temperatures ranging from -100°F. to +500°F. Teflon Technical Bulletin. Crane Packing Co.

Pulleys 63a Cites advantages of cast iron pulleys and includes data on belt idlers, gears, shafting, set collars, takeups, drive chains, pillow blocks, etc. Catalog 852. Jeffrey Mfg. Co.

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Heating & Cooling

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Condensate Drainage 28 Use of condensate drainage control systems for faster heat, higher temperature, uniform heating and lower maintenance. Covers features of Jet" principle. Pub. 3250. Cochrane Corp.

Condensers, Refrigeration 469N Refrigeration condensers for ammonia or freon refrigerant. Engineering data on full range of sizes & types for refrigeration service. 37 p. illustrated Bulletin RC-2. Henry Vogt.

Coolers, Cascade 323b Corrosion-resistance prevents chemical attack inside tubes & permits use of river or sea water as coolant. Heat transfer nomographs, tables, etc. Catalog PE-8. Corning Glass Works.

Coolers, Sample, Boiler Water 469O Includes installation & operation data, design specifications, charts to determine cooling water flow rate for various sample temperatures, etc. Bulletin 110. Davis Engrg. Corp.

Dehydrating & Dewatering 469P Fully illustrated 48 p. on equipment for most efficient and economical removal of moisture. Data on dehydrating products and engineering services available. Davenport Mach. & Foundry.

Dehydration Units 469Q Data on packaged dehydration units for efficient drying of air or other gases in all industrial, processing and laboratory installations. Illustrated Bulletin 16.0.081. J. F. Pritchard.

Technical Literature, cont'd.

Drying Systems, Flash 352a	Handle materials in which drying is combined with pulverizing, or with mild disintegration, or followed by cooling & conveying the product to storage. Catalog 54-A. Raymond Division.
Drying, Vacuum 295	Offers informative brochure, "Vacuum Drying," with data on the techniques of moisture removal from chemicals, pharmaceuticals and other industrial products. F. J. Stokes Machine.
Exchangers 318	Feature high thermal efficiency & ruggedness. All-copper & copper alloy exchangers are pre-engineered, fully standardized, & promptly available. Bulletin 1.1K5. Kewanee-Ross Corp.
Generators, Steam R415a	Economical & efficient, producing steam for process or heat. Fire-tube (20-600 b.h.p.), Catalog 622-F. Water-tube (200-1000 b.h.p.), Catalog 622-W. Superior Combustion.
Heat Exchange Equipment 455	Offers the advantages of fitting the equipment to specific needs—custom built from standard basic elements. Saves time, cost and design drudgery. Manning & Lewis Engineering Co.
Heat Exchangers 111	Sectional heat exchangers offer many advantages: flexibility; no obsolescence; reduced fouling; easy cleaning; reduced stores; etc. Details in Bulletin 512. Brown Flintube Co.
Heat Exchangers 93	40 p. designed to help solve heat exchanger problems. Contains data needed to work out capacity & type—arranged in tables, curves, charts. Heat Exchanger Manual 837. Pfaunder.
Heat Exchangers 164	Describes brazed aluminum heat exchangers for difficult heat transfer applications requiring close temperature approaches, multi-stream exchange, or low temperatures. Trane Co.
Heat Exchangers 18-91	Feature chemical resistance to practically all corrosive fluids, resistance to severe thermal shock, high heat-transfer rates, low maintenance, etc. Catalog S-6740. National Carbon.
Heaters, Electric 479A	Illustrated, 66 p. on electric heaters & heating devices. Covers units in terms of application, features, installation, pricing. 1954. Heating Catalog GEC-1005E. General Electric.
Heaters, Gas-Fired 89b	Will run on low-cost natural, manufactured or LP gas. 7 standard sizes with capacities from 25,000 to 200,000 BTU/H. Economy features in Catalog 1625. Westinghouse Electric Corp.
Heaters, Steam & Hot Water 89a	Offer many advantages—Instant, low-cost heat, dependability, easy installation, any application, design efficiency, quiet operation, etc. Catalog 1521. Westinghouse Electric Corp.
Heaters, Unit R403	Makes available literature on grid unit heaters. Heater is of cast iron construction that stands up against corrosive fumes in chemical plants. Catalog offered. D. J. Murray Mfg.
Heaters, Utility 479B	Lightweight, horizontal discharge heaters for general purpose heating. Feature "Featherfin" heating element with finned tubes of seamless drawn copper. L. J. Wing Manufacturing.
Heaters, Vertical 46	Find wide use in petroleum industry. For rich oil heating, gas and steam heating, catalytic reforming and many other heating requirements. Details in Bulletin C-45. Struthers-Weils.
Heating, Dowtherm 377	Illustrated, 28 p. includes useful engineering data, 136 different types and sizes to choose from, nine different complete system layouts, etc. Bulletin A-100. Eclipse Fuel Engrg. Co.
Platecoils 76	For tank heating & cooling problems due to inefficient pipe coils. Cost-saving Platecoils heat or cool 50% faster & take 50% less space in the tank. Bulletin P61. Tranter Mfg.
Pumping & Heating, Fuel Oil 554	Fuel oil pumping & heating units designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" oil & residuums. Bulletin 40. National Airoil Burner.
Refrigeration 404	Hundreds of different industrial applications of cooling systems now in operation throughout the world. Company makes available literature & quotations on request. Frick & Co.
Towers, Cooling 9	Intensive research and testing for more than a decade results in positive predetermination of cooling tower performance. Published results in Technical Bulletin R-52-P10. Marley.
Towers, Cooling 33	Offers many years of experience in the design and manufacture of cooling towers for every type of service. Details in illustrated bulletin, "Cooling Water for Industry." Fluor.
Traps, Steam R1405	Freeze-proof & freely installed outdoors. Non-air-binding feature facilitates heat transfer in severe weather. 1/4" to 2"; pressures to 250 lbs. Bulletin 853. W. H. Nicholson & Co.
Traps, Steam 233	Includes information on thermic bucket traps for speedy heat-up of off-and-on pipe coils, headers, unit heaters, etc. Catalog J. "Armstrong Steam Trap Book." Armstrong Machine.

Traps, Steam 12	Steam traps provide numerous advantages: more production; low initial cost and maintenance; easy installation; stainless steel construction; etc. Bulletin T-1740. Yarnall-Waring.
Tubes, Condenser 178	Condenser tubes represent utmost in installation and handling efficiency. Makes available "Condenser Tube Book" and "Handbook of Practical Packaging Practices." Wolverine Tube.

Services

Engineering & Construction 470C	Brochure to help guide company management and engineers in dealing with the complex problems of modernizing and expanding plant facilities in 16 p. Walter Kidde Constructors, Inc.
Hygiene, Industrial 470D	Describes the Industrial Hygiene Foundation at Mellon Institute. Covers growth, organization, activities, services, air pollution studies, plant-wide surveys, etc. Mellon Institute.
Medicine, Industrial 470E	Speaks of the true value of industrial medicine to management, how much it costs, what it does, & the future attainment of its full potential. Mellon Institute of Industrial Research.
Plant Location 400	Data on raw materials, transportation, power and fuel, markets, labor, facilities, sites, community services, laws & regulations. Physical map included. New York State Dept. of Commerce.
Plant Process Equipment 470F	Purchasing Guide contains classifications for hundreds of products made by 7 divisions. Includes plant process equipment, tool steels, non-ferrous alloys, etc. Continental Copper.
Polymer Directory 470G	Buyers Guide gives sources of "Kel-F" polymer materials, finished products, and application services offered by more than 75 United States and Canadian companies. M. W. Kellogg Co.
Production Equipment, Heavy 344	"Facilities and Products" includes data and photos which show why company can turn out at low cost-specialized heavy equipment for chemical plants. Newport News Shipbuilding.
Surveys, Company Business 470H	Over-all surveys for affirmative action in solving of company problems. Covers trends, policies, effectiveness of operations, weaknesses, betterments. Ford, Bacon & Davis.

Pipe, Fittings, Valves

Calculators, Valve Size 266b	Manufacturer of diaphragm control valves now makes available upon request a new valve size slide rule calculator which also includes low flow data. Kleley & Mueller, Inc.
Calculators, Valve Size 470I	New slide-chart calculators quickly estimate pressure drop and indicate proper size steam valve needed for any pressures up to 1500 psi. Includes technical data. Golden-Anderson.
Fittings 34a	Master Catalog describes the complete range of products . . . compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic & silicone rubbers. Klinger Corp.
Fittings 310-1	304 p. on forged & seamless welding pipe fittings & flanges. Presents a line broad & completely integrated in types, sizes, ratings & materials. Fittings Catalog 55. Ladish.
Fittings, Flare 158-9	Proven absolutely leakproof even under severest conditions of vibration, high pressures & temperatures. Available in wide range of shapes & sizes. Catalog 4300. Parker Appliance Co.
Fittings, Welding 90	Precision-process manufacture begins with the billet, continues thru the making of the seamless steel tube, & extends thru to production of the finished fittings. Globe Steel Tubes.
Hose, Flexible 165a	For air, water, other fluids & gases. Easier to handle because it is light, strong & flexible, has no pre-set twist, coils & uncoils easily. Bulletin 6879. Raybestos-Manhattan.
Hose, Metal Flexible 305a	For practically unlimited engineering uses—simplifies design, construction, operation & maintenance. Types of hose, fittings, etc. in 45 p. Metal Hose Catalog 200. Titeflex, Inc.
Hose, Metal, Flexible 470J	Illustrated, 32 p. features company's manufacture of Rex-Weld corrugated metal hose, Rex-Tube convoluted hose types, Rex-Flex stainless steel flexible metal hose, etc. Flexonics.
Joints, Swing 58b	Designed to provide for movement & flexibility in metal pipe loading or unloading lines which handle petrochemicals, oil, alcohol and other fluids. Offers Catalog 400. Barco Mfg. Co.
Nozzles, Spray TL415	48 p. industrial catalog offers complete data on thousands of standard and special nozzles for every type of spraying. Includes related equipment. Catalog 24. Spraying Systems Co.

Pipe & Fittings 18-9b	For superior corrosion-resistance. Impervious graphite pipe and fittings readily installed, durable, easily maintained, resist corrosive fluids. Catalog S-7000. National Carbon Co.
Pipe & Fittings 417-8a	Recognized as a leader in the field of welding fittings and flanges and as a source of authentic information of piping design. Offer "Pipe and Fitting Materials." Tube Turns.
Pipe & Fittings, Glass 471A	Small diameter glass pipe & special fittings for use in process piping, pilot plant piping, instrumentation lines, etc. Covers specifications in Bulletin SQ-11. Sentinel Glass Co.
Pipe & Fittings, Installation 325a	Durable glass pipe offers clear transparency, non-contamination, corrosion resistance, light weight. Catalog EA-3. Picture-pages of installations in Catalog EA-1. Corning Glass Works.
Pipe, Fittings & Valves 360	Corrosion-resistant saran lined pipe, fittings, & valves offer greater dependability & longer life—assure tight, leakproof joints. Saran rubber data booklet. Saran Lined Pipe Co.
Pipe, Seamless & Welded 471B	Aids in selection, application & installation of carbon, alloy & stainless steel pipe. Data on dimensions, weights, specifications, analyses, etc. in TDC 138 A. Babcock & Wilcox.
Porcelain Products, Chemical 471C	Complete line of chemical porcelain pipe, fittings, spacers, vertical check valves, hand-wheel valves, plug valves, swivel joints, etc. Illustrated Bulletin CP-50. U. S. Stoneware.
Tubes, Copper 265	Contains data on copper tubes—applications, advantages & installation. Includes numerous reference tables for user & installer. Illustrated Publication C-24. American Brass Co.
Tubing, Stainless 35	Slide Chart with physical properties, sizes & gauges, cross-sectional areas, velocity constants, pressures, etc. on stainless tubing for heat exchanger applications. Carpenter.
Valve Prices 471D	Covers data on prices and critical dimensions for bonnet stock and bonnetless stock valves, wedge gate valves, swing check valves, butterfly valves, etc. Fabri-Valve Co. of America.

Valves 391	Easily operated, non-lubricated, maintenance-free valves reduce down time and costs. Built of corrosion-resisting alloys with a teflon sleeve. Descriptive literature. Durlon Co.
Valves 471E	48 p. cover valves extensively used on guided missiles, aircraft, military automotive equipment and for general industrial application. Illustrated Catalog 200. Robertshaw-Fulton.
Valves 108	Feature protection against excessive stress with new extra-strong stem & wedge gate connection, super-hardened seat rings of stainless steel, etc. Catalog 10. Chapman Valve.
Valves 103-3	Lubricant-sealed for positive shut-off. Built in a wide range of sizes, pressures, special metals and body designs for the process industries. Bulletin V-217. Rockwell Mfg. Co.
Valves 50-1a	Makes available OIC Catalog Digest for quick valve selection. Information on various kinds of valves in bronze, iron, cast steel, forged steel, stainless steel. Ohio Injector Co.
Valves 471F	Built for use in conjunction with light weight pipe & fittings. Complete weldments from rolled plate-eliminating porous areas & insuring proper thickness where designed. Fabri-Valve.
Valves, Air, Wobble-Kod 471G	New flexibility in automatic, semi-automatic & manual control of pneumatic circuits. Includes applications, specifications' price data in illustrated Bulletin 61861. Pantex Mfg. Corp.
Valves, Automatic Shut-Off 471H	For protection of gages and instruments in hydraulic or pneumatic systems against overload. Covers features, specifications, adjustment & installation data. Sprague Engrg. & Sales.
Valves, Diaphragm Control 266a	Valves feature contour molded diaphragms, two-bolt patented continuous seal method for positive diaphragm casing closure, etc. Details in Bulletin CV63. Kieley & Mueller, Inc.
Valves, Electro-Hydraulic 471I	Small, compact servo valves for use in control systems requiring high accuracy. Covers applications, design, specifications, frequency response, etc. Bulletin 600. Moog Valve Co.

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6-7b	32a	57	82	117	184E	173	247	273	286B	306b	331	366a	391	R411a	L426d	T454	465G	467H	469O	
6-7c	32b	58-9a	83a	119	185	174	249	274A	286C	306c	332	366b	392	R411b	L426e	455	465H	467I	469P	
6-7d	33	58-9b	83b	121	186A	175	253	274B	286D	306d	333	367	393	412	L426f	456	465I	467J	469Q	
8	34a	60	83c	123	186B	176-7	256-7a	274C	286E	306e	334	368	394a	L413	L426g	457	465J	468A	470A	
9	34b	61	84	125	186C	178	256-7b	274D	286F	306f	336	369	394b	TR413	L426h	458	465K	468B	470B	
10	34c	62-8a	85	127	186D	179	256-7c	275	286G	306g	337	370	395	BR413	L426i	464A	465L	468C	470C	
11	35	62-8b	86	129	186E	180a	256-7d	276A	287	305h	339a	371a	396a	414	TR426	464B	465M	468D	470D	
12	36-7a	62-8c	87	131	186F	180b	256-7e	276B	288A	309	339b	371b	396b	TL415	BR426	464C	465N	468E	470E	
13	36-7b	62-8d	88	133	186G	181	256-7f	276C	289a	307	339c	371c	397	BL415	427	464D	465O	468F	470F	
14	36-7c	62-8e	89a	137	186H	182	256-7g	276D	289b	308	339d	371d	L398	R415a	TL428	464E	465P	468G	470G	
16	38	62-8f	89b	139	186I	213	256-7h	276E	290A	309	339e	371e	R398	R415b	TR428	464F	465Q	468H	470H	
17	39	62-8g	90	141	187	215a	256-7i	277	290B	310-1	340-1	372a	399	L416	BR428	464G	465R	468I	470I	
18-9a	40	62-8h	91	143	188-9	215b	256-7j	278A	290C	312	342	372b	400	R416	BL428	464H	465S	468J	471A	
18-9b	41	62-8i	93	145	190	217	256-7k	278B	290D	313	343	372c	401	417-8a	429a	464I	465T	468K	471B	
18-9c	42-3	64a	94	146	191	219	256-7l	279C	290E	314	344	373	402	417-8b	429b	464J	465U	468L	471C	
18-9d	44	64b	95a	147	192-3	221	256-7m	278D	290F	315	345	374	403	L420a	TL430	464K	465V	468M	471D	
18-9e	45a	65a	95b	148A	164	223a	256-7n	278E	291	316-7a	350	375	404	L420b	BL430	464L	465W	468N	471E	
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18-9g	46c	66	95d	150A	165b	223c	256-7p	279b	292B	316-7c	352b	377	406	BL405	M420	TR435	464N	465Y	468P	471G
18-9h	46	67	95e	160B	165c	224	259	280A	292C	316-7d	352b	378	407	R405	R420	BR435	464O	465Z	468Q	471H
18-9i	47	68	95f	160C	165d	225a	265	280B	292D	318	353c	379	408	L422	TL435	464P	465A	468R	471I	
20-1	48	69	96-7a	160D	165e	225b	266a	280C	292E	319	354	380	L407	M422	TR436a	464Q	465B	468S	472A	
22	49	70	96-7b	160E	165a	229	266b	280D	293	320-1a	355	381	TR407	R422	TR436b	464R	465C	468T	472B	
23	50-1a	71-2	96-7c	161	166b	231	268-9a	281	295	320-1b	356	382	BR407	L423	TR436c	464S	465D	468U	472C	
24-5a	50-1b	73a	98	162A	166c	233	268-9b	282A	296	322	357	383	408a	TR423	TR436d	464T	465E	468V	472D	
24-5b	50-1c	73b	99	162B	166d	234-5	268-9c	282B	297	323a	358	384	408b	BR423	TR436e	464U	465F	468W	472E	
26a	50-1d	74	100	163C	167	237	268-9d	282C	299	323b	359	385	408c	424	439	464A	465G	468X	472F	
26b	50-1e	75	101	162D	168a	239	268-9e	282D	300	323c	360	386	408d	TL425	440a	465B	467C	469J	472G	
26c	50-1f	76	102	163E	168b	241	268-9f	282E	302	324	361	387	T409	BL425	440b	465C	467D	469K	472H	
26d	52	77	103	163	168	199	243-4a	270A	282F	303a	325	362	388a	B409	R426	TL442	465D	467E	469L	472I
26e	53	78	104	164A	170a	243-4b	271	283	303b	326	363a	388b	410	L429a						
27	54	79	107	164B	170b	245a	272A	284A	303c	330a	363b	388c								

... And these items in the Reader Service "Flashback" Section (p. 473)

138A	138C	140B	142A	142D	142F	142H	280A	280C	280E	282A	282C	282E	284A	288A	288C	288E	290A	292B	292D
138B	138D	140C	142B	142E	142G	278A	280B	280D	280F	282B	282D	282F	286A	288B	288D	288F	292A	292C	292E
138E	140A	140D	142C																

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1 2 3 4 11 15 17 21 22 22a 22b 25 26 28 33 34 35 36 37 38 39 40 41 42 43

Technical Literature, (cont'd.)

Valves, Gate 44	Describes advantages of rubber lined iron body gate valves for corrosive services up to 150° F. Feature fully revolving double disc, parallel seat principle. Darling Valve & Mfg.
Valves, Gate 381	150 pound steel gate valves offer exceptional performance for the petroleum industry. Suitable for temperatures up to 1000°F & available in sizes from 2 to 24 inches. Crane Co.
Valves, Lubricated Plug 14	Plug valves offer new dependability with teflon gaskets. Gasket characteristics: can't bind; self lubricating; pressure tight; etc. Catalog No. 4-CM. American Car & Foundry Co.
Valves, Packless 48	Eliminate leakage & wastage & protect against possible fire, explosion or other damage. Rugged, seamless metal bellows replaces customary packing. Bulletin AC-813. Fulton Siphon.
Valves & Pressure Switches 475A	Illustrated, 20 p. covers pressure switches & valves. Includes valves for manual control of Vacuum or pressures up to 4000 psi, solenoid valves, etc. Catalog 3G. Barksdale Valves.
Valves, Relief 478B	Makes available new publication "Your Handbook on Temperature and Pressure Relief Valves." Explains and illustrates the function of relief valves in 16 p. A. W. Cash Valve Mfg. Corp.
Valves, Relief 479C	Superior features of hydraulic cartridge type relief valves. Durable units designed for operation over temperature range from -65°F to +160°F. Illustrated Bulletin AD. Pantex Mfg.
Valves, Solenoid 472D	Three way solenoid valves for corrosive gases, liquids and steam up to 450°F. Covers general description, features, applications, operation, etc. Bulletin 8300. Automatic Switch.

Miscellaneous

Cameras, Roll Film 472E	Supplement plate camera furnished with Type EMT Electron microscopes. Permit multiple exposures with single loading. Specifications & features in Catalog EM-418. Radio Corp. of America.
Filter Aids 38	Filter aids used by food processors to produce sugar, shortening, salad oils, jellies, etc. Includes information on filters, insulation, & other aids to industry. Dicalite Division.
Filter Media BR436a	Offers illustrated literature, "Equipment and Materials for Filtering and Liquid Handling." Includes data on filter paper, filter cloth, asbestos pads, etc. Filpaco Industries.
Fire Extinguishers 472F	Automatic sprinkler type fire extinguishers designed to permit quick & economical installation of fire protection directly over fire hazards. Details in Bulletin SP-763. Stop Fire, Inc.
Fire Extinguishers 22	For faster, more effective & dependable fire-stopping power. Extinguishers of all sizes—from small models to piped systems & 2000 lb. stationary units. File B-202. Ansul Chem. Co.
Fire Protection, Foam 85	Illustrated booklet with data on the advantages of foam. Tested on petroleum or polar-solvents fires. Checked as to extinguishment time, foam volume, sealability. National Foam System.
Laboratory Planning Kits 472G	For simplified modular planning. Includes plastic guide rule & template corresponding to 1/4" to 1 ft. scale, with rectangular cutouts representing various base units. Metabol Equip.
Nameplates, Decal TL430	Shows hundreds of uses for durable, washable decal nameplates . . . as trademarks, instruction charts or diagrams—in any size, colors or design. Offers Nameplate Manual. Meyercoed Co.
Photocopying Machines 373	Print, process & dry automatically. Kit offers data on machines & folders on copying tax returns, color copying on preprinted forms. American Photocopy Equipment Co.
Reproduction Materials Charts 83	Wall charts help select reproduction material offering best results in reproducing any type of drawing or other original in any type of print-making equipment. Eastman Kodak Co.

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CHEMICALS

Adhesives, pressure 138C
Aluminum pastes, non leafing. 142D
Aluminum, porcelain
 enameled 136A
Detergents, low-suds 140D
Emulsifiers, for insecticides. 138D
Filter aids 138A
Floor paint, nonskid 142B
Gum, guar, refined 140A
Lauryl sulfates 142F
Lubricants, wide temperature
 range 142A
Mildew preventive 138B

Mold release agent 142C
Packing compounds,
 self-molding 142H
Silicone rubber 140B
Vegetable wax 142G
Zinc stearate, dispersible . . . 142E

EQUIPMENT

Alloys, nickel 288D
Analyzers, hydrogen 278A
Bagging machines 292A
Bearings, roller 282D
Benders, tubing 282F
Carbide, cemented chrome . . 288E

Centrifugals, dewatering . . . 284A
Coding machines 292C
Controllers, liquid level 280B
Conveyors, packing 292B
Couplings, flexible 282E
Domes, vapor 290A
Extractors, liquid-liquid 286A
Fabricators, alloy 288F
Flooring, concrete 288B
Lamps, trouble 282A
Micro-micrometers 280A
Motors 282C
 Chemically resistant 282B
Rotary dumper 292D
Smokestack, glass-lined 288A
Spectrophotometer 280E
 Recording 280F
Thermometers, mercury dial. . 280C
Valves, temperature control. . 280D
Vibrators, car 292E
Wire, metallizing 288C

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6-7a	29	56	81	111	154D	172	245e	272C	286A	305a	330e	365	390	BL411	L426e	B454	465F	467G	469N	
6-7b	32a	57	82	117	154E	173	247	273	286B	305b	331	366a	391	R411a	L426d	T454	465G	467H	469O	
6-7c	32b	58-9a	83a	119	155	174	249	274A	286C	305c	332	366b	392	R411b	L426e	455	465H	467I	469P	
6-7d	33	58-9b	83b	121	156A	175	253	274B	286D	305d	333	367	393	412	L426f	456	465I	467J	469Q	
8	34a	60	83c	123	156B	176-7	256-7a	274C	286E	305e	334	368	394a	L413	L426g	457	465J	468A	470A	
9	34b	61	84	125	156C	178	256-7b	274D	286F	305f	336	369	394b	TR413	L426h	458	465K	468B	470B	
10	34c	62-3a	85	127	156D	179	256-7c	275	286G	305g	337	370	395	BR413	L426i	464A	465L	468C	470C	
11	35	62-3b	86	129	156E	180a	256-7d	276A	287	305h	339a	371a	396a	414	TR426	464B	465M	468D	470D	
12	36-7a	62-3c	87	131	156F	180b	256-7e	276B	288A	306	339b	371b	396b	TL415	BR426	464C	465N	468E	470E	
13	36-7b	62-3d	88	133	156G	181	256-7f	276C	289a	307	339c	371c	397	BL415	427	464D	465O	468F	470F	
14	36-7c	62-3e	89a	137	156H	182	256-7g	276D	289b	308	339d	371d	L398	R415a	TL428	464E	465A	468G	470G	
15	38	62-3f	89b	139	156I	213	256-7h	276E	290A	309	339e	371e	R398	R415b	TR428	464F	465B	468H	470H	
17	39	62-3g	90	141	157	215a	256-7i	277	290B	310-1	340-1	372a	399	L416	BR428	464G	465C	468I	470I	
18-9a	40	62-3h	91	143	158-9	215b	256-7j	278A	290C	312	342	372b	400	R416	BL428	464H	465D	468J	471A	
18-9b	41	62-3i	93	145	160	217	256-7k	278B	290D	313	343	372c	401	417-8a	429a	464I	465E	468K	471B	
18-9c	42-3	64a	94	146	161	219	256-7l	278C	290E	314	344	373	402	417-8b	429b	464J	465F	468L	471C	
18-9d	44	64b	95a	147	162-3	221	256-7m	278D	290F	315	345	374	403	L420a	TL430	464K	465G	468M	471D	
18-9e	45a	65a	95b	148A	164	223a	256-7n	278E	291	316-7a	350	375	404	L420b	BL430	464L	465H	468N	471E	
18-9f	45b	65b	95c	149	165a	223b	256-7o	279a	292A	316-7b	351	376	405	TL405	L420c	431	464M	465I	468O	471F
18-9g	45c	66	95d	160A	165b	223c	256-7p	279b	292B	316-7c	352a	377	406	BL405	M420	TR435	464N	465J	468P	471G
18-9h	46	67	95e	160B	165c	224	259	280A	292C	316-7d	352b	378	407	R405	R420	BR435	464O	465K	468Q	471H
18-9i	47	68	95f	160C	165d	225a	265	280B	292D	318	353a	379	408	L422	TL435	464P	465L	468R	471I	
20-1	48	69	96-7a	160D	165e	225b	265a	280C	292E	319	354	380	L407	M422	TR436a	464Q	465M	468S	471J	
22	49	70	96-7b	160E	165a	229	265b	280D	293	320-1a	355	381	TR407	R422	TR436b	464R	465N	468T	472A	
23	50-1a	71-2	96-7c	161	166b	231	268-9a	281	295	320-1b	356	382	BR407	L423	TR436c	464S	465O	468U	472C	
24-5a	50-1b	73a	98	162A	166c	233	268-9b	282A	296	322	357	383	408a	TR423	TR436d	464T	465P	468V	472D	
24-5b	50-1c	73b	99	162B	166d	234-5	268-9c	282B	297	323a	358	384	408b	BR423	TR436e	464U	465Q	468W	472E	
26a	50-1d	74	100	162C	167	237	268-9d	282C	298	323b	359	385	408c	424	439	465A	467B	469I	472F	
26b	50-1e	75	101	162D	168a	239	268-9e	282D	300	323c	360	386	408d	TL425	440a	465B	467C	469J	472G	
26c	50-1f	76	102	162E	168b	241	268-9f	282E	302	324	361	387	T409	BL425	440b	465C	467D	469K	472H	
26d	52	77	103	163	169	243-4a	270A	282F	303a	325	362	388a	B409	R425	TL442	465D	467E	469L	472I	
26e	53	78	104	164A	170a	243-4b	271	283	303b	326	363a	388b	410	L426a						
27	54	79	107	164B	170b	245a	272A	284A	303c	330a	363b	388c								

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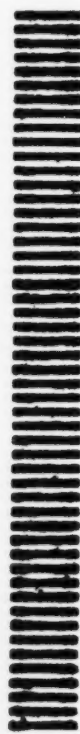
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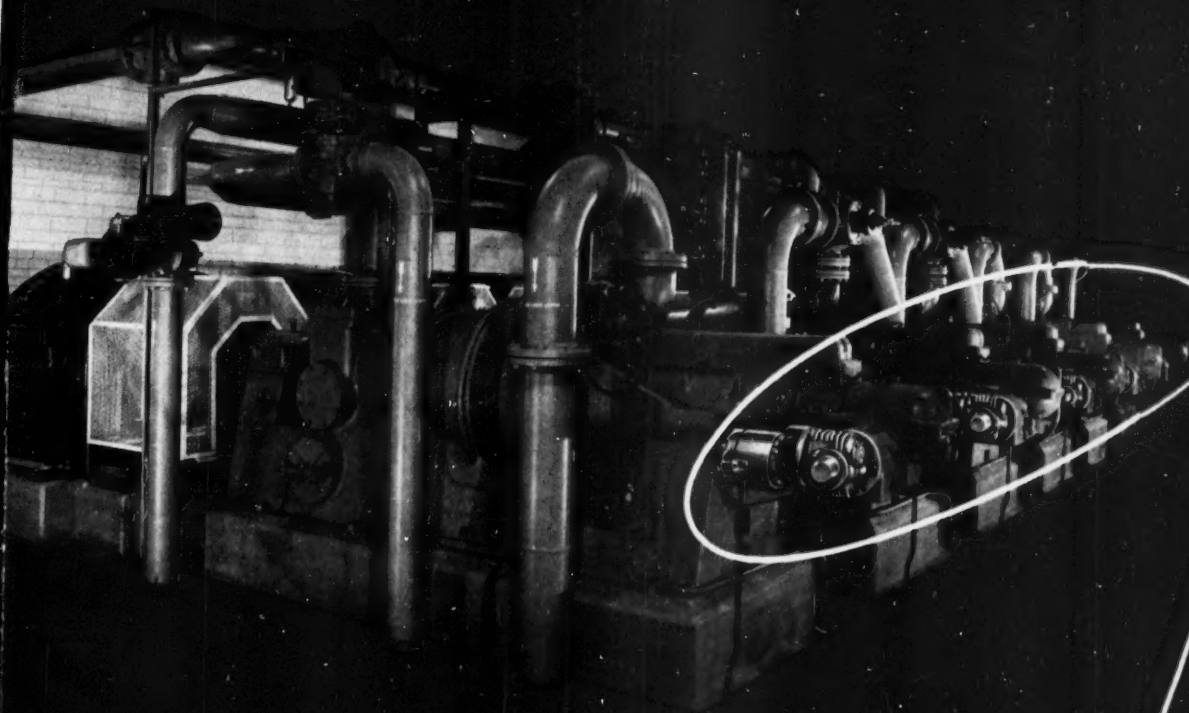
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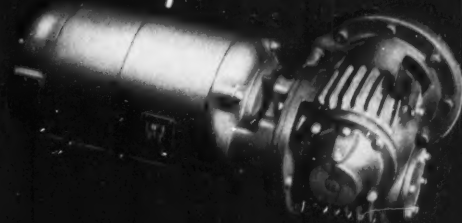
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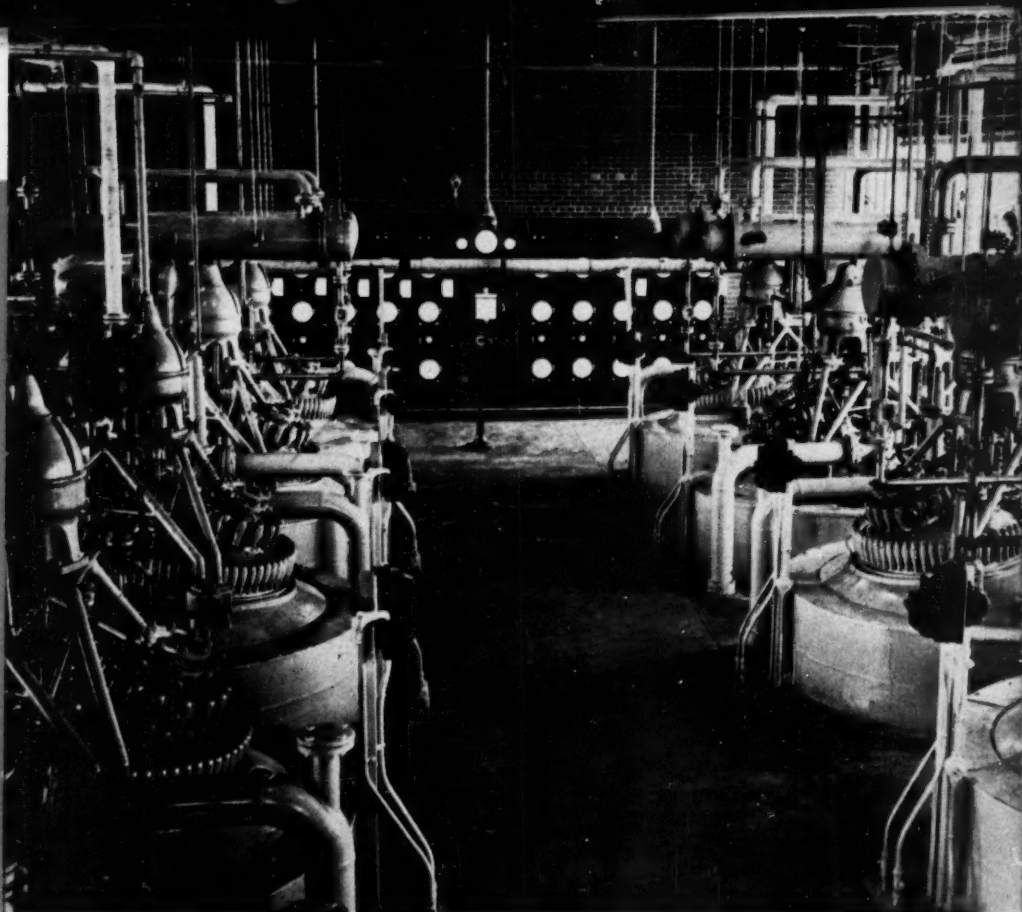
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